

Indoor Rowing Sailing Guide

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Section 1

How To Use This Guide

This Guide is intended for Sailors of a number of different sailing classes, ages and athletic ability (called Athlete Levels in this Guide). Section 3 **Getting Started** applies to all Sailors and should be read very carefully to ensure full understanding.

Section 4 describes the physiological demands of the various sailing classes and details training plans relevant to each class.

Whilst you only need to read the sub section of Section 4 that applies to your own sailing class you may, out of interest, want to read about the other sailing classes.

The tests in Sections 5.1 and 5.2 apply to all Sailors and are crucial to establishing your personal Athlete Level to use with the training plans.

Having established your Athlete Level and the appropriate training plan you only need the Pace Guide in Section 6 (**the indoor rower monitor displays a number of variables - pace is shown as minutes:seconds/500m rowed**) to get started on your indoor rowing training.

In addition to the tests you will need, Section 5 also includes the results of tests used by the Great Britain Olympic Sailing Team and the Indoor Rowing World Records so that you can compare your performance against elite Sailors and Indoor Rowers.

About The Author:

Eddie Fletcher is a sport and exercise physiologist and specialist indoor rowing coach. He is coach to a number of World and British Indoor Rowing champions and record holders and has written a number of guides specifically for indoor rowers. There is extensive indoor rowing information and advice on his website: www.fletchersportscience.co.uk

Note: You are recommended to read the whole guide before embarking on your training plan - in particular make sure you understand the guidance on training by heart rate and do not embark upon a training plan if injured or feeling unwell. If in doubt consult your doctor before you commence training. This Guide is for adults, children under 18 should seek the advice of a qualified coach.

Section 2

Why Indoor Rowing for Sailors?

When I first started to look at the suitability of using the Concept 2 indoor rower as a training tool for Sailors it came as no surprise to me to hear that the physical and physiological demands of sailing included – **power, strength, aerobic conditioning, agility and core strength**. Obviously the physiological demands vary by sailing class but elements of each are present across the range.

The Great Britain Olympic Sailing Team use the Concept 2 Indoor Rower to test fitness and to develop the power, strength and aerobic fitness needed to meet the physiological demands of competitive sailing. This guide shares this knowledge so that competitive and club Sailors can mirror the use of the indoor rower by top Sailors with training plans tailored to individual fitness level.

This Guide avoids the use of training zone terminology where possible – terms such as lactate threshold, aerobic, anaerobic are much debated, disputed and misunderstood terms. The aim of this Guide is not to explain the terminology or science but to offer realistic training plans, relative to the sailing class, that all Sailors can follow. Obviously some explanations are necessary but these are kept to a minimum.

For clarity training plans are standardised using duration (in minutes) stroke rate and percentage of maximum heart rate to make the plans accessible to all. The training plans have been designed using data obtained by the author over a number of years from users of the indoor rower and from data supplied by the Great Britain Olympic Sailing Team.

To get the best out of the indoor rower it is important to understand how to set up the machine and how to row with good technique. Readers should obtain a copy of the Concept 2 technique DVD for reference and carefully read Sections 3.3 and 3.4 of this guide.

It is reasonable to ask the question why Indoor Rowing for Sailors?

The American College of Sports Medicine makes the following recommendations for the quality and quantity of fitness/training needed for developing and maintaining cardio-respiratory fitness in healthy adults:

- The activity should be one that uses large muscle groups, is maintained continuously and is rhythmical or aerobic in nature
- The duration should be from 20-60 minutes of continuous exercise
- Training should be regular 3 to 5 times per week



Photo: Laser Sailing © Richard Langdon/Skandia Team GBR

- The intensity of the exercise should raise the heart rate to between 60-85% of maximum heart rate
- Strength training of moderate intensity should be added twice a week

Rowing satisfies these recommendations and for Sailors has a number of advantages over other forms of training:

- 1 Rowing is a non-impact exercise; it places less impact-related wear and tear on the body. This is especially important for combating over- use injuries
- 2 The rowing machine provides a fitness workout that utilizes every major muscle group in the body as well as working the heart, lungs and circulatory system through a complete range of fitness/training intensities and adds variety to your training programme
- 3 It offers a time-efficient method to improve aerobic capacity and reduce body fat (Weight is important in some sailing classes e.g. 49er - most boats aim for 148 kg or 155 kg weight band, Laser and Windsurfer classes)
- 4 It can provide excellent power/strength workouts that will develop the physiological qualities needed for example, by a 49er crew member when hoisting the spinnaker. This is a crucial part of a crew's role and takes approximately 5-7 seconds of flat out effort
- 5 Rowing can be done indoors anytime, important when you are not able to get out sailing due to inclement weather
- 6 It is a safe and effective way of training whilst recovering from certain injuries
- 7 Rowing on the Concept2 Indoor Rower provides an accurate means for monitoring your level of conditioning, and offers constant feedback whilst rowing. For example, you can train, using the heart rate monitor interface (Polar PM3/PM4 and/or Suunto on the latest PM4 monitor) in heart rate training zones that are clearly defined and applicable to you.

Section 3

Getting Started

3.1 General Guidelines

The training plans are specific to each sailing class, there are three plans for each sailing class based on 5 Athlete Levels (this will allow you to use the Concept 2 Interactive Training Plan as an alternative): (See www.concept2.co.uk/training/interactive.php)

1. **Athlete Levels 1 and 2** based on 2 sessions a week
2. **Athlete Levels 3 and 4** based on 3 sessions a week
3. **Athlete Level 5** based on 3/4 sessions a week

For some of the sailing classes there is an optional extra session to reflect specific needs of that sailing class.

At any Athlete Level it is recommended that 2 sessions per week is the minimum to get the best out of training with the indoor rower. Sailors in Athlete Levels 3-5 may drop sessions as time permits as long as training sessions are kept in sequence.

Each plan is designed to help development of the **aerobic fitness, power and strength** required for each of the sailing classes outlined in Section 4.

Sailors over 50 years of age should restrict training to Level 1 and 2 or Level 3 and 4 – Level 5 should not be attempted if over 50 years of age unless you are an experienced indoor rower.

Each plan builds over 16 weeks and should be timed so that the final week finishes a week before the first sailing race of the season.

To use these plans you need to know:

- **Your Athlete Level from an O'Neil 4 minute Fitness Test or from a 2000m indoor rowing time (Section 5.1)**
- **Your maximum heart rate - MHR (from a test or estimate, Section 5.2)**
- **Your resting heart rate – RHR**

O'Neil 4 minute Fitness Test

The O'Neil Aerobic Capacity Test www.concept2.co.uk/training/oneill_test.php is outlined in Section 5.1 and is designed to give a simple and reliable test of aerobic capacity. Aerobic capacity is a good indicator of general condition as it underpins 95% of all forms of activity.

Maximum heart rate (MHR)

Maximum heart rate is the highest possible heart rate you can achieve. There are a number of formulae to calculate your maximum heart rate based on your age. However actual maximum heart rate may vary as much as 20-30 beats from a calculated value. An indoor rowing specific test is the only realistic way of assessing this value.

The maximum heart rate test outlined in Section 5.2 is extremely demanding and should only be attempted by **experienced or competitive indoor rowers**. If inexperienced, despite the inaccuracy use a simple formula of 220 minus your age until fit enough to carry out the maximum heart rate test in Section 5.2.

Resting Heart Rate (RHR)

Resting heart rate is the lowest number of beats per minute when you are at complete rest. Resting heart rate will change as a result of regular training so this is a variable to update periodically – indoor rowers who have trained over long periods tend to have exceptionally low heart rates – low 50s, 40s and even into the 30s.

The best way to establish your resting heart rate is to check first thing in the morning as soon as you wake up. Check it for a few days to get a settled reading.

Heart Rate Reserve

The training plans use a method called '**heart rate reserve**' (HRR) for calculating a training zone – this method takes into account your resting heart rate. For example if a session shows a heart rate range of 70% to 75% and you have a maximum heart of 176 and a resting heart rate of 50 then the calculation is:

$$\begin{aligned} \text{Lower limit} &= 176 \text{ (MHR)} - 50 \text{ (RHR)} = 126 \times 70\% = 88 + 50 \text{ (RHR)} = 138 \\ \text{Upper limit} &= 176 \text{ (MHR)} - 50 \text{ (RHR)} = 126 \times 75\% = 95 + 50 \text{ (RHR)} = 145 \end{aligned}$$

Range for the session 70%-75% = heart rate of 138-145

Once you have established your Athlete Level, maximum heart rate and resting heart rate you will be ready to apply the information to your specific training plan – example:

Finn Sailor

Male Aged 44

Maximum heart rate (estimate) $220 - 44 = 176$

Resting heart rate (measured) 50

O'Neil 4 minute fitness test distance rowed = 1101m (section 5.1)

Athlete Level = 3

2000 m estimate = 7 minutes 16 seconds
(1101 m = 1 minute 49 seconds per 500 m x 4 = 7 minutes 16 seconds)

Training Plan Interpretation

Week 1, Session 1 from Level 3 and 4 training plan for a Finn sailor (section 4.2)

2 x 15' 90" r @ 18 70-75%HRR

This means row for 15 minutes at 18 strokes per minute keeping heart rate in the range of 70-75% of **heart rate reserve** rest for 90 seconds then repeat.

15 minutes at 18 strokes, heart rate in the range 138-145 (70-75% using heart rate reserve method) at a pace of 2 minutes 12 seconds per 500 m (from the Pace Guide in Section 6 for a 2000 m time of 7 minutes 16 seconds)

Week 1, Session 4 (short burst) from the Level 3 and 4 training plan

12 x 10" 30" r @ 32-36

This means row for a 10 second burst at 32-36 strokes, then row gently for 30 seconds, repeat this 12 times

The Overriding Consideration Is Heart Rate

If your heart rate reaches the top end of the heart rate range shown for a session you should reduce the pace to match the heart rate

DO NOT EXCEED THE UPPER LIMIT OF THE HEART RATE RANGE FOR ANY OF THE SUGGESTED TRAINING SESSIONS

Whenever your heart reaches the upper limit you should reduce your pace until your heart rate recovers

IF YOUR HEART RATE REMAINS TOO HIGH SLOW THE PACE DOWN UNTIL YOUR HEART RATE REDUCES AND THEN WORK STRICTLY WITHIN THE HEART RATE RANGE FOR THE SESSION IRRESPECTIVE OF THE PACE

Stroke rate is also important

Keep within the stroke rates shown for each session – the lower end of the stroke rate range is preferable. The stroke rate range reflects different rowing styles and individual physical and physiological factors but for any individual training session you should not exceed the upper stroke rate limit.

REST DAYS ARE COMPULSORY.

Take a realistic view of your overall exercise or training programme and build in at least one and possibly two rest days per week.

Do not hesitate to take extra rest days if you feel you have not recovered from a prior session. It is always sensible to miss the occasional session if it aids recovery.

Do not train if ill or injured and when you start training again always go back to week 1 sessions for a few days reducing your heart rate for the session by 5% (e.g. 75% down to 70% etc.) with a corresponding reduction in pace.

3.2 Warm Up And Cool Down

Warm up and cool down are vital components of training.

The purpose of a warm up is to increase muscle and core temperature, blood flow and improve the uptake, transport and utilisation of oxygen as well as providing a comfortable way to lead into more vigorous 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).

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

Warm up stretches the muscle tendons allowing greater length and less tension on exposure to the start of a training session. Injuring a warmed up muscle requires greater force than required to injure a cold muscle.

Cool down is as important as warm up. It helps to reduce lactate build up, return heart rate, core temperature and breathing to normal and prevents stiffness. 10 minutes of gentle rowing can be sufficient to reduce lactate levels to near normal.

The table below gives you the approximate time you should spend warming up and warming down depending on the training session – for ease of clarity use the stroke rate of the session to identify the correct time to spend warming up and warming down.

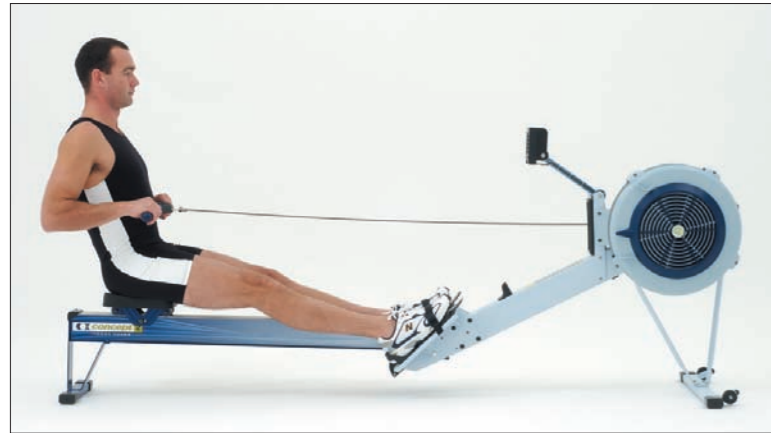
Session Stroke Rate	Warm Up	Cool Down
18	5-8 min	5-8 min
20-24	8-10 min	8-10 min
24-28	10-12 min	10-12 min
28-30	12-15 min	12-15 min
32-36	15-20 min	15-20 min

If you decide to take part in a 2000m indoor rowing race a good warm up procedure is important – correct warm up can increase performance by up to 1%.

See www.fletchersportscience.co.uk/show_article.php?id=news45bb4aed725cd for full details.

3.3 Technique

Technique is the most important factor when using the rowing machine. If you get your technique right you'll be efficient, produce better scores/results and avoid potential injuries. Three-times world champion Tom Kay illustrates ideal form.



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



The Drive - Full Slide
The Beginning

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

Arms extend, body rocks forward

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



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



The Slide
AFTER the arms have fully extended and the body rocked forward, slide forward maintaining arm and body position.

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

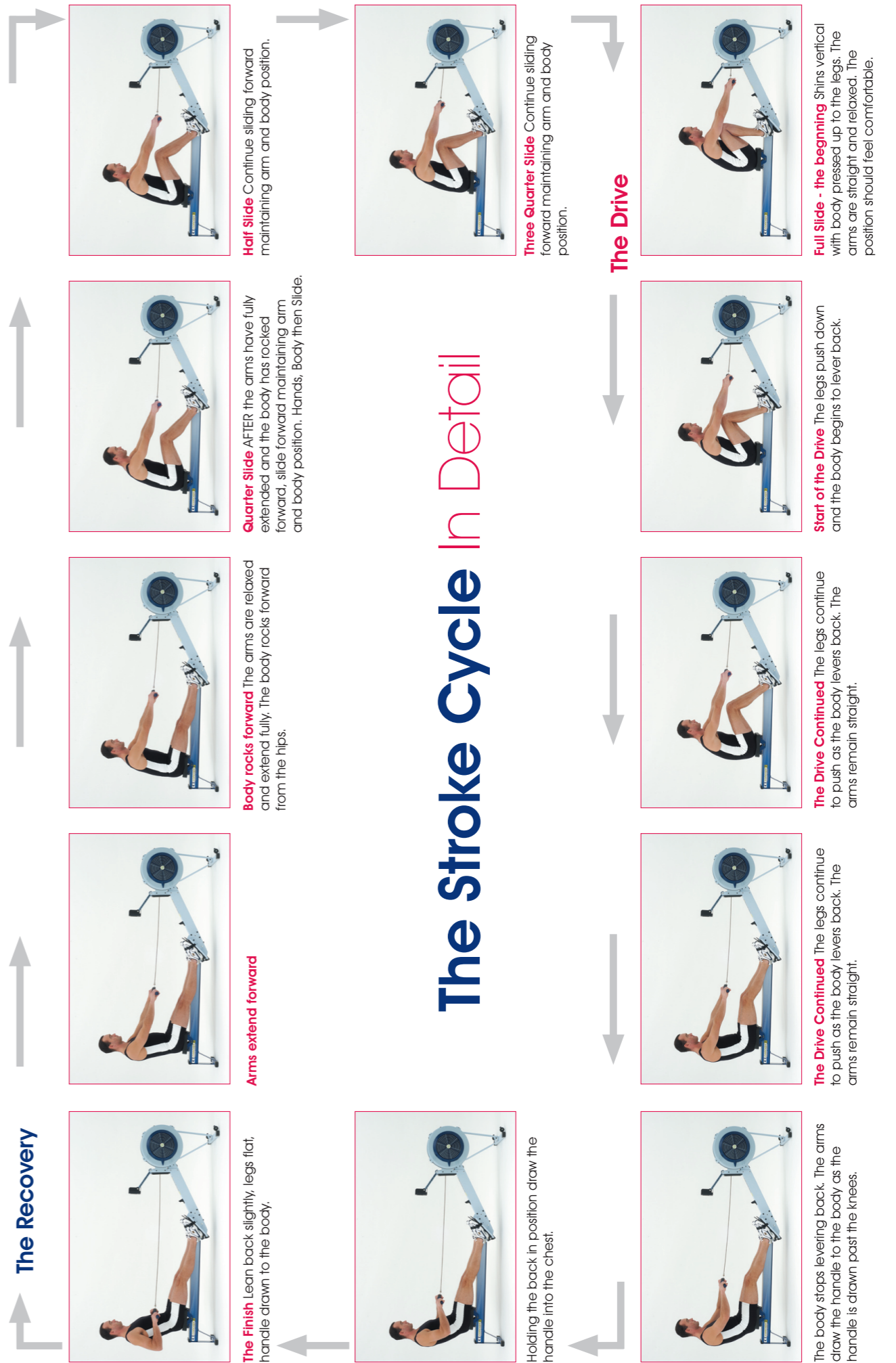
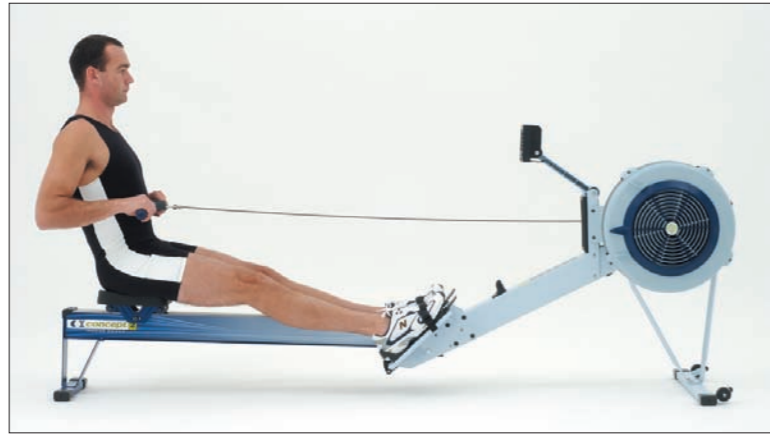


3.3 Technique continued



The body stops levering back
The arms draw the handle past the knees and then strongly to the body, returning to the Finish position. Legs flat, forearms horizontal.

The Finish
Lean back slightly, legs flat, handle drawn to the body. Forearms horizontal. You are now ready to take the next stroke. *The full stroke cycle is pictorially displayed on the opposite page.*



3.4 Damper/Drag Factor Setting

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 frictional force of the air opposing the flywheel rotation. The monitor display of the flywheel is a numerical calculation using the acceleration, speed of rotation and moment of inertia.

The damper lever on the side of the fan cage controls the drag factor. With the damper set to level 10 more air can pass across the fan increasing the rate of deceleration (drag). The monitor detects the increase in drag and an adjustment is made to the pace readout. 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. **It is important to note that the damper level is not an indication of how fast you can go level 10 is not fast and level 1 is not slow.**

If the perforations on the fan cage become clogged, then to achieve the same drag factor the damper lever will need to be put on a higher setting. The monitor detects the effect on the flywheel not the position of the damper lever so although the setting on different machines may not be the same, the drag factor reading will always be correct.

Rowers use the machine in the drag factor range of 125 to 140 or level 3 to 4. The reason for this is that at this level the feel is closest to that of a racing boat therefore making the training rowing specific enabling them to replicate their rhythm and rate from the water. Good rowing technique is about speed of application of power and not just brute strength. It is a question of trial and error to find the most suitable setting for each individual. Once you have found the ideal set up note the drag factor rather than the damper lever setting, as drag factor will remain constant across different machines.

The table below illustrates the recommended drag settings for sailors

Drag – A Reminder

LEARN HOW TO SET THE DRAG FACTOR ON YOUR INDOOR ROWER

Always set the drag exactly the same for every training session.

As a general guideline drag should be set at:

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

To display drag factor on a PM2/PM2+, press [1/0] to power on the monitor then press [OK]+[REST] together.

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



Section 4

Physiological Demands of Sailing & Training Plans

Jargon Buster

In the descriptions of the physiological demands of the various sailing classes you will see reference to oxygen consumption and oxygen uptake.

Heart rate indicates the transfer of blood and oxygen to muscles.

Oxygen consumption indicates how the muscles use the oxygen for work. Oxygen consumption increases in a linear manner as exertion increases and is considered to be the most reliable variable to estimate training or race intensity.

Oxygen consumption is directly dependent on the amount of work your body does. The region in which oxygen consumption plateaus or increases only slightly with additional increases in exercise intensity represents the maximal oxygen consumption (or uptake).

Maximal oxygen uptake is a personal value, affected by your training history and genes. A common misconception is that maximum oxygen uptake directly describes your performance level.

Performance is determined by how close to the maximum level you are able to maintain performance throughout training or racing and by the economy of the performance. Economy means how much of the oxygen consumed by your body converts into performance.

Oxygen consumption remains more or less the same or slightly decreases for a set standard training session, while maximal oxygen uptake may increase as fitness improves.

Absolute maximum oxygen uptake is measured in litres. Often it is quoted as millilitres per kilogram of body weight per minute (ml/kg/min). Absolute maximal oxygen uptake is the more appropriate measure for rowing.



Photo: Penny Clark © Richard Langdon/Skandia Team GBR

4.1 Physiological Demands Of Laser And Laser Radial

The Laser is one of the most popular single-handed dinghies in the world due to its strict one design, robustness and simplicity; both to rig and hull while the performance characteristics match those of more complex racing dinghies.

It is an 'open' class sailed by males and females. Women generally use the Laser Radial which is based on the same hull and equipment as the Laser. The Radial has a smaller sail and a different more flexible lower section mast. Everything else is unchanged.

The typical length of a Laser race is approximately 45-60 minutes - it is normal to have 2 or even 3 races a day and anything up to 12 races making a series.

The physiological demands of single-handed sailing, in particular Laser sailing have been summarized by some researchers as "demanding relatively low energy expenditure" and "not being particularly taxing aerobically". In the view of Dr Pete Cunningham some of the research is a little misleading as it has mostly been conducted in non racing situations which in his view make a major difference to the findings.

It is difficult to work in the field, hence the lack of data in the scientific journals highlighting what actually happens physiologically during racing at an elite level. Role models like Ben Ainslie, Iain Percy and Hugh Styles, who were all successfully sailing Laser in the early 1990s and helped promote physiology and were all believers in the need to be physically fit.

Ben Ainslie's success and dominance in the Laser class from 1995 to 2000 helped to support Dr Cunningham's view of the physiological requirements of Laser sailing and has also fuelled interest in the physical fitness that is required from younger sailors.

Physiological profile of elite Laser & Laser Radial sailors:

	Laser Men	Laser Radial Women
Body weight:	78-82 kg	66-68 kg
Sum of skinfolds:	50-75 mm	60-95 mm
Estimated Body fat:	10-12%	20-26%
Height:	1.78 – 1.88 m	1.66 – 1.76 m
40 second sprint performance Peak Power:	558 – 699 watts	500 - 640 watts



Photo: © Richard Langdon / Skandia Team GBR

Requirements – Laser

Upper body strength – Some light sailors e.g. 74 kgs normally lack upper body strength. Upper body is the ideal place for weight gain as this is most beneficial to the righting moment when hiking out the side of the boat.

Aerobic fitness – the amount of recovery upwind will depend on the ability to consume oxygen.

Weight control – ensuring the correct body weight and body fat percentage.

Core strength – A crucial element for any single handed sailor - rowing should be an integral part of any good all round training plan.

Specific rowing sessions can be targeted at improving aerobic conditioning and weight control.

Heart Rate Requirements - Laser

The normal picture for Laser sailing in winds above 10 knots is an average heart rate of over **80% of maximum heart rate**.

Heart rate may peak at close to **90% of maximum heart rate** in the strongest wind conditions - this peak coincides with rounding the windward buoy. The upwind heart rate is approximately 15 beats/min higher than downwind heart rate.

As soon as the wind speed reaches approx. 9-10 knots (i.e. the start of hiking) heart rate is elevated to around **75% of maximum heart rate** and increased by a further 10 beats/min with further increases in wind speed.

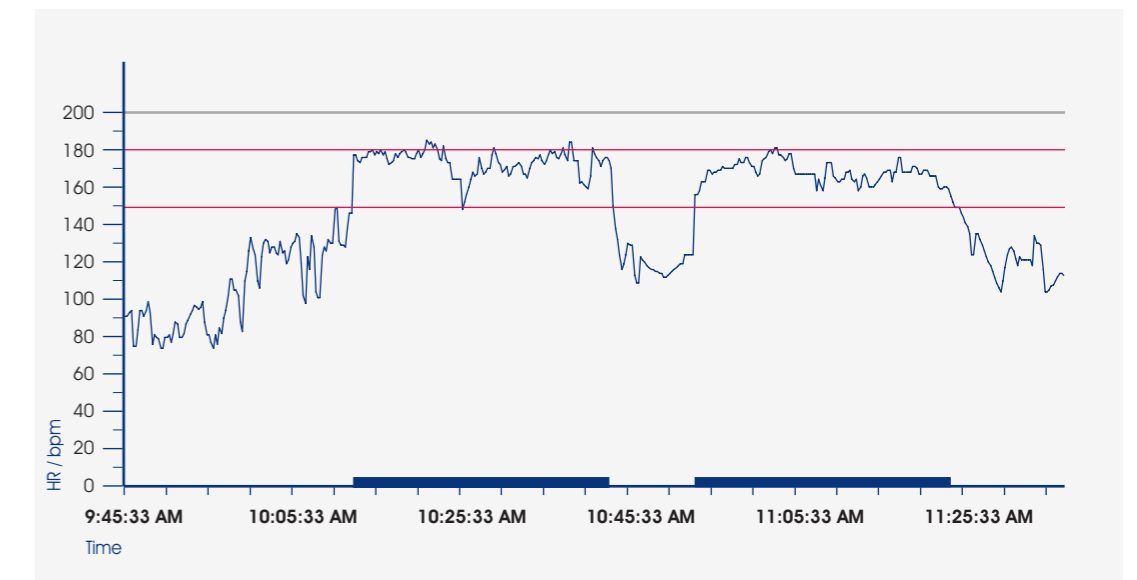
This suggests that there is a significant physiological stress placed on the elite dinghy sailor. Aerobic fitness is an important element that an elite Laser sailor needs to concentrate on. Muscular endurance of the hiking muscles, in particular the quadriceps and the abdominal muscles, are crucial to performance. Upper body strength and muscular endurance are also important for correct sail trimming.

Heart rates are elevated upwind mainly due to the dynamic movement of the sailor. Hiking a Laser is not a static task, any elite sailor will constantly move in two planes trying to get the most out of a rather light weight boat. First, there is the in and out movement via flexion and extension around the hip joint. This movement is necessary to cope with the ever changing wind conditions.

Second, there is the movement of the upper-body up and down the boat via an aggressive twisting movement from the hips and in some cases a whole body movement up and down the boat. This movement is an attempt to get maximal performance out of the boat in the prevailing sea conditions - the light weight of the Laser allows the momentum of the sailor (in a jerking fashion) to have a big influence in getting the boat over waves and chop.

The dynamic action of constantly playing the mainsheet will undoubtedly also elevate heart rates. Dr Cunningham feels strongly that an aerobic element should form a large part of a Laser sailors training programme.

Heart rate trace from male Laser Sailor racing in 15-18 knots of wind – 2 races (max heart rate 195 b.min⁻¹).



Laser Training Plan

Athlete Level 1 & 2

Week/Session	1	2
Phase 1	4 minute Test	
1	2 x 12' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 20-22 70-80%HRR
2	2 x 15' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 22-24 75-85%HRR
3	2 x 18' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 24-26 80-85%HRR
4	2 x 12' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 20-22 70-80%HRR
Phase 2	4 minute Re-test	
5	2 x 15' 90" r @ 18 65-70%HRR	3 x 8' 4' r @ 22-24 75-85%HRR
6	2 x 18' 90" r @ 18 65-70%HRR	3 x 8' 4' r @ 24-26 80-85%HRR
7	2 x 20' 90" r @ 18 65-70%HRR	3 x 8' 5' r @ 26-28 85-90%HRR
8	2 x 15' 90" r @ 18 65-70%HRR	3 x 8' 4' r @ 22-24 75-85%HRR
Phase 3	4 minute Re-test	
9	2 x 18' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 24-26 80-85%HRR
10	2 x 20' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 26-28 85-90%HRR
11	2 x 23' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 28-30 90%HRR
12	2 x 28' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 24-26 80-85%HRR
Phase 4	4 minute Re-test	
13	2 x 12' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 24-26 85%HRR
14	2 x 15' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 26-28 85-90%HRR
15	2 x 18' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 28-30 90%HRR
16	2 x 12' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 24-26 85%HRR

* HRR = Heart Rate Reserve – see page 9

Laser Training Plan

Athlete Level 3 & 4

Week/Session	1	2	3
Phase 1	4 minute Test		
1	2 x 15' 90" r @ 18 65-75%HRR	3 x 10' 5' r @20-22 70-80%HRR	2 x 15' 90" r @ 18 65-70%HRR
2	2 x 18' 90" r @ 18 65-75%HRR	3 x 10' 5' r @22-24 75-85%HRR	2 x 18' 90" r @ 18 65-70%HRR
3	2 x 20' 90" r @ 18 65-75%HRR	3 x 10' 5' r @24-26 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR
4	2 x 15' 90" r @ 18 65-75%HRR	3 x 10' 5' r @20-22 70-80%HRR	2 x 15' 90" r @ 18 65-70%HRR
Phase 2	4 minute Re-test		
5	3 x 12' 90" r @ 18 65-75%HRR	3 x 8' 4' r @22-24 75-85%HRR	3 x 12' 90" r @ 18 65-70%HRR
6	2 x 20' 90" r @ 18 65-75%HRR	3 x 8' 4' r @24-26 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR
7	2 x 23' 90" r @ 18 65-75%HRR	3 x 8' 5' r @26-28 85-90%HRR	2 x 23' 90" r @ 18 65-70%HRR
8	3 x 12' 90" r @ 18 65-75%HRR	3 x 8' 4' r @22-24 75-85%HRR	3 x 12' 90" r @ 18 65-70%HRR
Phase 3	4 minute Re-test		
9	2 x 20' 90" r @ 18 65-75%HRR	3 x 6' 3' r @24-26 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR
10	2 x 23' 90" r @ 18 65-75%HRR	3 x 6' 3' r @26-28 85-90%HRR	2 x 23' 90" r @ 18 65-70%HRR
11	2 x 25' 90" r @ 18 65-75%HRR	3 x 6' 3' r @28-30 90%HRR	2 x 25' 90" r @ 18 65-70%HRR
12	2 x 20' 90" r @ 18 65-75%HRR	3 x 6' 3' r @24-26 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR
Phase 4	4 minute Re-test		
13	2 x 15' 90" r @ 18 65-75%HRR	4 x 4' 3' r @24-26 80-85%HRR	2 x 15' 90" r @ 18 65-70%HRR
14	2 x 18' 90" r @ 18 65-75%HRR	4 x 4' 3' r @26-28 85-90%HRR	2 x 18' 90" r @ 18 65-70%HRR
15	2 x 20' 90" r @ 18 65-75%HRR	4 x 4' 3' r @28-30 90%HRR	2 x 20' 90" r @ 18 65-70%HRR
16	2 x 15' 90" r @ 18 65-75%HRR	4 x 4' 3' r @24-26 80-85%HRR	2 x 15' 90" r @ 18 65-70%HRR

* HRR = Heart Rate Reserve – see page 9

Laser Training Plan

Athlete Level 5

Week/Session	1	2	3	4
Phase 1	4 minute Test			
1	2 x 20' 5 r @ 20-22 70-80%HRR	2 x 18' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 65-75%HRR
2	2 x 20' 5 r @ 22-24 75-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 65-75%HRR
3	3 x 10' 5 r @ 26-28 85-90%HRR	2 x 23' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 24-26 80-85%HRR	2 x 23' 90" r @ 18 65-75%HRR
4	2 x 20' 5 r @ 20-22 70-80%HRR	2 x 18' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 65-75%HRR
Phase 2	4 minute Re-test			
5	2 x 20' 5 r @ 20-22 75-80%HRR	2 x 20' 90" r @ 18 65-70%HRR	3 x 8' 4' r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 65-75%HRR
6	2 x 20' 5 r @ 22-24 80-85%HRR	2 x 23' 90" r @ 18 65-70%HRR	3 x 8' 4' r @ 24-26 80-85%HRR	2 x 23' 90" r @ 18 65-75%HRR
7	3 x 10' 5 r @ 26-28 90%HRR	2 x 25' 90" r @ 18 65-70%HRR	3 x 8' 5' r @ 26-28 85-90%HRR	2 x 25' 90" r @ 18 65-75%HRR
8	2 x 20' 5 r @ 20-22 75-80%HRR	2 x 20' 90" r @ 18 65-70%HRR	3 x 8' 4' r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 65-75%HRR
Phase 3	4 minute Re-test			
9	2 x 20' 5 r @ 20-22 75-80%HRR	2 x 23' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 24-26 80-85%HRR	2 x 23' 90" r @ 18 65-75%HRR
10	2 x 20' 5 r @ 22-24 80-85%HRR	2 x 25' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 26-28 85-90%HRR	2 x 25' 90" r @ 18 65-75%HRR
11	3 x 10' 5 r @ 26-28 90%HRR	2 x 30' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 28-30 90%HRR	2 x 30' 90" r @ 18 65-75%HRR
12	2 x 20' 5 r @ 20-22 75-80%HRR	2 x 23' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 24-26 85%HRR	2 x 23' 90" r @ 18 65-75%HRR
Phase 4	4 minute Re-test			
13	2 x 20' 5 r @ 20-22 70-80%HRR	2 x 18' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 24-26 85%HRR	2 x 18' 90" r @ 18 65-75%HRR
14	2 x 20' 5 r @ 22-24 75-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 26-28 85-90%HRR	2 x 20' 90" r @ 18 65-75%HRR
15	3 x 10' 5 r @ 26-28 90%HRR	2 x 23' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 28-30 90%HRR	2 x 23' 90" r @ 18 65-75%HRR
16	2 x 20' 5 r @ 20-22 70-80%HRR	2 x 18' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 24-26 85%HRR	2 x 18' 90" r @ 18 65-75%HRR

* HRR = Heart Rate Reserve – see page 9





Photo: Ben Ainslie © Richard Langdon / Skandia Team GBR

4.2 Physiological Demands Of Finn Sailing

The Finn is a high-performance sailboat and ranks as one of the world's great boats. Because each rig is tailored to each individual's style, so sailing ability is key and superior sailing ability generally wins.

A one-man centerboard dinghy, the Finn requires tremendous physical exertion and mental concentration. This combination of excellent craft with sophisticated competitor makes Finn racing unique.

Finn sailors are strong, fit and tolerant of long periods of concentration and physical exertion. They are tall and heavy and train hard for competition. They are known as well-rounded athletes with proven general sailing skills.

At the Finn Class World Championship (The Finn Gold Cup) the race length is approximately 2 hours, it is normal to have one race per day with 6 or 7 races making a series. At Olympic level the races are generally a bit shorter lasting between 60-75 minutes with the possibility of 2 races per day and 11 races normally making a full series.

In winds above 10 knots the Finn class has a 'free pumping flag' rule which means that pumping and body movements are allowed, which clearly increases the physiological demands.

Sailing the Finn is perhaps the purest athletic experience in world class sailing equaled perhaps only by the windsurfer. Because the sail is fully adjustable and its shape bears directly on performance and boat speed the Finn is extremely responsive. Mastery of the craft is never quite fully achieved. Finn sailors may have sailed the craft for years yet find some small nuance of tactics, weight or other adjustment yielding a greater result.

Although the Finn is a single-hander it is very different physiologically from Laser sailing. The Finn is commonly referred to as the most physical of all dinghies – the major difference being the large area and additional power of the main-sail in comparison to the Laser and the fact that the boat is much heavier than the Laser.

Physiological Profile Of An Elite Finn Sailor:

Body weight: 95 - 106 kg
Sum of 8 skinfolds: 70 - 120 mm
Estimated Body fat: 12 - 20%
Height: 1.80 - 1.96 m
40 second sprint performance Peak Power: 701 – 978 watts

Requirements – Finn

Power and strength – weight training is an essential part of Finn training, the large and powerful sail requires strength in order to control sail trim, sailing upwind and perform 'one to one' pumping when sailing downwind.

Aerobic fitness – the amount of recovery will depend on the ability to consume oxygen

Core strength – A crucial element for any single handed sailor - rowing should be an integral part of any good all round training plan

Specific rowing sessions can be targeted at improving power and strength and aerobic conditioning.

Heart Rate Requirement - Finn

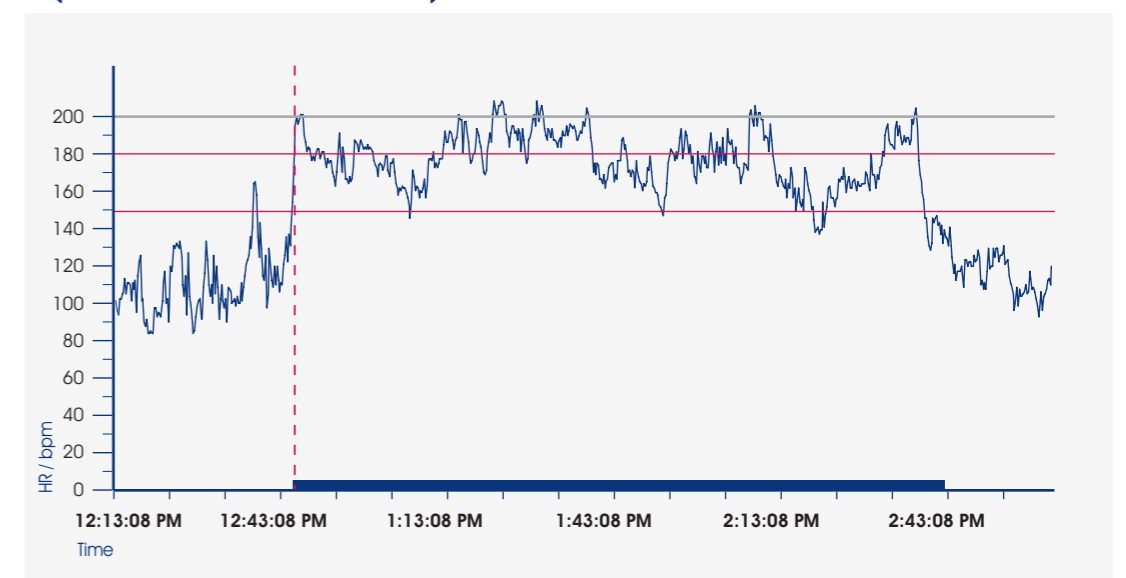
Whilst there may be minimal aerobic demands placed on a Finn sailor during light wind conditions the converse applies in strong conditions where heart rate may reach over 80% of maximum heart rate. The average heart rate is not dissimilar to that of a Laser sailor but there are two notable differences first, the length of a Finn race is 2 hours (at the World Championships) and second, in complete contrast to a Laser sailor the higher heart rate is obtained sailing downwind as opposed to sailing upwind.

This is a true reflection of the physiological demands of Finn sailing. Downwind the sailor can pump the mainsail one to one (the main-sheet coming straight from the boom and not going through the ratchet pulley system) – thus the loads are very high. Repetitive pumping is very aerobic and produces elevated heart rates which may reach over 90% of maximum heart rate.

Upwind heart rates vary between 70%-80% of maximum heart rate with a few peaks reaching 80%-85% of maximum heart rate. The main reason why heart rates sailing upwind are lower than those for Laser sailing is because of the weight of the Finn makes the boat less manoeuvrable.

The Finn is a much heavier boat than the Laser which results in less body movement (often termed bouncing or ouching). The Finn sailor's posture upwind is quite static when compared to a Laser sailor and subsequently heart rates are lower.

Heart rate trace from a Finn sailor racing in 15 knots of wind (max heart rate 202 b.min⁻¹).



Finn Training Plan

Athlete Level 1 & 2

Week/Session	1	2	3 Short burst session
Phase 1	4 minute Test		OPTIONAL
1	2 x 12' 90" r @ 18 65-70%HRR	3 x 10' 5' r @20-22 75-80%HRR	10 x 10" 30" r @ 32-36
2	2 x 15' 90" r @ 18 65-70%HRR	3 x 10' 5' r @22-24 80-85%HRR	10 x 15" 30" r @ 32-36
3	2 x 18' 90" r @ 18 65-70%HRR	3 x 10' 5' r @24-26 80-85%HRR	10 x 20" 30" r @ 32-36
4	2 x 12' 90" r @ 18 65-70%HRR	3 x 10' 5' r @20-22 75-80%HRR	10 x 10" 30" r @ 32-36
Phase 2	4 minute Re-test		
5	2 x 15' 90" r @ 18 65-70%HRR	3 x 8' 4' r @22-24 80-85%HRR	12 x 10" 30" r @ 32-36
6	2 x 18' 90" r @ 18 65-70%HRR	3 x 8' 4' r @24-26 80-85%HRR	12 x 15" 30" r @ 32-36
7	2 x 20' 90" r @ 18 65-70%HRR	3 x 8' 5' r @26-28 85-90%HRR	12 x 20" 30" r @ 32-36
8	2 x 15' 90" r @ 18 65-70%HRR	3 x 8' 4' r @22-24 80-85%HRR	12 x 10" 30" r @ 32-36
Phase 3	4 minute Re-test		
9	2 x 18' 90" r @ 18 65-70%HRR	3 x 6' 3' r @24-26 80-85%HRR	15 x 10" 30" r @ 32-36
10	2 x 20' 90" r @ 18 65-70%HRR	3 x 6' 3' r @26-28 85-90%HRR	15 x 15" 30" r @ 32-36
11	2 x 23' 90" r @ 18 65-70%HRR	3 x 6' 3' r @28-30 90%HRR	15 x 20" 30" r @ 32-36
12	2 x 28' 90" r @ 18 65-70%HRR	3 x 6' 3' r @24-26 80-85%HRR	15 x 10" 30" r @ 32-36
Phase 4	4 minute Re-test		
13	2 x 12' 90" r @ 18 65-70%HRR	4 x 4' 3' r @24-26 85%HRR	10 x 10" 30" r @ 32-36
14	2 x 15' 90" r @ 18 65-70%HRR	4 x 4' 3' r @26-28 85-90%HRR	10 x 15" 30" r @ 32-36
15	2 x 18' 90" r @ 18 65-70%HRR	4 x 4' 3' r @28-30 90%HRR	10 x 20" 30" r @ 32-36
16	2 x 12' 90" r @ 18 65-75%HRR	4 x 4' 3' r @24-26 85%HRR	10 x 10" 30" r @ 32-36

* HRR = Heart Rate Reserve – see page 9

Finn Training Plan

Athlete Level 3 & 4

Week/Session	1	2	3	4 Short burst session
Phase 1	4 minute Test			OPTIONAL
1	2 x 15' 90" r @ 18 70-75%HRR	3 x 10' 5' r @ 20-22 75-80%HRR	2 x 15' 90" r @ 18 65-70%HRR	12 x 10" 30" r @ 32-36
2	2 x 18' 90" r @ 18 70-75%HRR	3 x 10' 5' r @ 22-24 80-85%HRR	2 x 18' 90" r @ 18 65-70%HRR	12 x 15" 30" r @ 32-36
3	2 x 20' 90" r @ 18 70-75%HRR	3 x 10' 5' r @ 24-26 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	12 x 20" 30" r @ 32-36
4	2 x 15' 90" r @ 18 70-75%HRR	3 x 10' 5' r @ 20-22 75-80%HRR	2 x 15' 90" r @ 18 65-70%HRR	12 x 10" 30" r @ 32-36
Phase 2	4 minute Re-test			
5	3 x 12' 90" r @ 18 70-75%HRR	3 x 8' 4' r @ 22-24 80-85%HRR	3 x 12' 90" r @ 18 65-70%HRR	15 x 10" 30" r @ 32-36
6	2 x 20' 90" r @ 18 70-75%HRR	3 x 8' 4' r @ 24-26 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	15 x 15" 30" r @ 32-36
7	2 x 23' 90" r @ 18 70-75%HRR	3 x 8' 5' r @ 26-28 85-90%HRR	2 x 23' 90" r @ 18 65-70%HRR	15 x 20" 30" r @ 32-36
8	3 x 12' 90" r @ 18 70-75%HRR	3 x 8' 4' r @ 22-24 80-85%HRR	3 x 12' 90" r @ 18 65-70%HRR	15 x 10" 30" r @ 32-36
Phase 3	4 minute Re-test			
9	2 x 20' 90" r @ 18 70-75%HRR	3 x 6' 3' r @ 24-26 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	18 x 10" 30" r @ 32-36
10	2 x 23' 90" r @ 18 70-75%HRR	3 x 6' 3' r @ 26-28 85-90%HRR	2 x 23' 90" r @ 18 65-70%HRR	18 x 15" 30" r @ 32-36
11	2 x 25' 90" r @ 18 70-75%HRR	3 x 6' 3' r @ 28-30 90%HRR	2 x 25' 90" r @ 18 65-70%HRR	18 x 20" 30" r @ 32-36
12	2 x 20' 90" r @ 18 70-75%HRR	3 x 6' 3' r @ 24-26 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	18 x 10" 30" r @ 32-36
Phase 4	4 minute Re-test			
13	2 x 15' 90" r @ 18 70-75%HRR	4 x 4' 3' r @ 24-26 85%HRR	2 x 15' 90" r @ 18 65-70%HRR	12 x 10" 30" r @ 32-36
14	2 x 18' 90" r @ 18 70-75%HRR	4 x 4' 3' r @ 26-28 85-90%HRR	2 x 18' 90" r @ 18 65-70%HRR	12 x 15" 30" r @ 32-36
15	2 x 20' 90" r @ 18 70-75%HRR	4 x 4' 3' r @ 28-30 90%HRR	2 x 20' 90" r @ 18 65-70%HRR	12 x 20" 30" r @ 32-36
16	2 x 15' 90" r @ 18 70-75%HRR	4 x 4' 3' r @ 24-26 85%HRR	2 x 15' 90" r @ 18 65-70%HRR	12 x 10" 30" r @ 32-36

* HRR = Heart Rate Reserve – see page 9

Finn Training Plan

Athlete Level 5

Week/Session	1	2	3	4	5 short burst session
Phase 1	4 minute Test				OPTIONAL
1	2 x 20' 5 r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 70-75%HRR	15 x 10" 30" r @ 32-36
2	2 x 20' 5 r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 22-24 80-85% HRR	2 x 20' 90" r @ 18 70-75%HRR	15 x 15" 30" r @ 32-36
3	3 x 10' 5 r @ 26-28 90%HRR	2 x 23' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 24-26 80-85%HRR	2 x 23' 90" r @ 18 70-75%HRR	15 x 20" 30" r @ 32-36
4	2 x 20' 5 r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 70-75%HRR	15 x 10" 30" r @ 32-36
Phase 2	4 minute Re-test				
5	2 x 20' 5 r @ 20-22 80%HRR	2 x 20' 90" r @ 18 65-70%HRR	3 x 8' 4' r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 70-75%HRR	18 x 10" 30" r @ 32-36
6	2 x 20' 5 r @ 22-24 80-85%HRR	2 x 23' 90" r @ 18 65-70%HRR	3 x 8' 4' r @ 24-26 80-85%HRR	2 x 23' 90" r @ 18 70-75%HRR	18 x 15" 30" r @ 32-36
7	3 x 10' 5 r @ 26-28 90%HRR	2 x 25' 90" r @ 18 65-70%HRR	3 x 8' 5' r @ 26-28 85-90%HRR	2 x 25' 90" r @ 18 70-75%HRR	18 x 20" 30" r @ 32-36
8	2 x 20' 5 r @ 20-22 80%HRR	2 x 20' 90" r @ 18 65-70%HRR	3 x 8' 4' r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 70-75%HRR	18 x 10" 30" r @ 32-36
Phase 3	4 minute Re-test				
9	2 x 20' 5 r @ 20-22 80%HRR	2 x 23' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 24-26 80-85%HRR	2 x 23' 90" r @ 18 70-75%HRR	20 x 10" 30" r @ 32-36
10	2 x 20' 5 r @ 22-24 80-85%HRR	2 x 25' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 26-28 85-90%HRR	2 x 25' 90" r @ 18 70-75%HRR	20 x 15" 30" r @ 32-36
11	3 x 10' 5 r @ 26-28 90%HRR	2 x 30' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 28-30 90%HRR	2 x 30' 90" r @ 18 70-75%HRR	20 x 20" 30" r @ 32-36
12	2 x 20' 5 r @ 20-22 80%HRR	2 x 23' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 24-26 80-85%HRR	2 x 23' 90" r @ 18 70-75%HRR	20 x 10" 30" r @ 32-36
Phase 4	4 minute Re-test				
13	2 x 20' 5 r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 24-26 85%HRR	2 x 18' 90" r @ 18 70-75%HRR	15 x 10" 30" r @ 32-36
14	2 x 20' 5 r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 26-28 85-90%HRR	2 x 20' 90" r @ 18 70-75%HRR	15 x 15" 30" r @ 32-36
15	3 x 10' 5 r @ 26-28 90%HRR	2 x 23' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 28-30 90%HRR	2 x 23' 90" r @ 18 70-75%HRR	15 x 20" 30" r @ 32-36
16	2 x 20' 5 r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 24-26 85%HRR	2 x 18' 90" r @ 18 70-75%HRR	15 x 10" 30" r @ 32-36

* HRR = Heart Rate Reserve – see page 9





Photo: Hannah Mills / Katrina Hughes © Richard Langdon / Skandia Team GBR

4.3 Physiological Demands Of 470 Sailing

The everyman boat of competitive racing - the 470 - is sailed by young or old experienced or beginner. The 470 is two-handed centerboard boat high performance dinghy which can be sailed by anyone. A light and narrow boat the 470 responds easily and immediately to body movement.

The sailors teamwork and tactics complement one another. The skipper is usually smaller and lighter and the crew is taller and heavier. The crew hangs out the side of the boat on a trapeze and thus has a greater influence on the righting moment of the boat.

The 470 dinghy is sailed by both male and female sailors. The 470 has a crew of two where the helm hikes and the crew trapezes. Sail set up includes a spinnaker, main and jib. A typical race length is approximately 60 minutes – with 2 or 3 races per day and normally 11 races make a complete series.

The 470 class also has a rule that in winds above approximately 10 knots a 'free pumping flag' is raised allowing unlimited pumping of the sails and body movements at will which clearly increases the physiological demands.

Physiological profile of an elite 470 male helm:

Body weight: 58 kg
Sum of 8 skinfolds: 35-65 mm
Estimated Body fat: 10%
Height: 1.72 – 1.76 m
40 second sprint performance Peak Power: 397 – 650watts

Physiological profile of an elite 470 female helm:

Body weight: 53-58 kg
Sum of 8 skinfolds: 75-95 mm
Estimated Body fat: 20%
Height: 1.60 – 1.70 m
40 second sprint performance Peak Power: 408 – 457 watts

Heart Rate Requirement – 470 helm

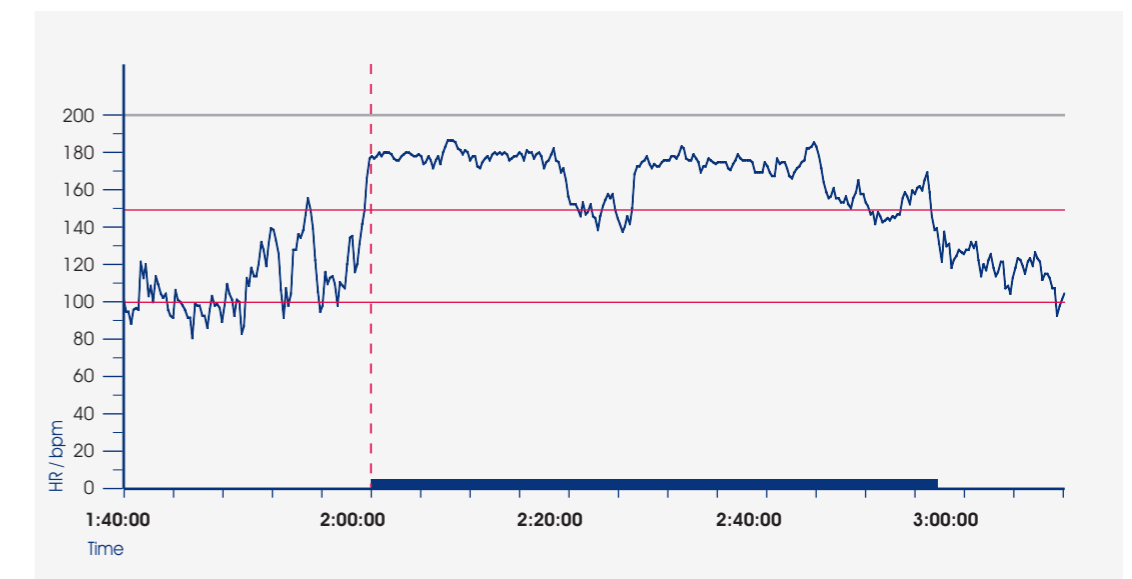
In winds above 10 knots the upwind heart rate may reach in excess of 85% of maximum heart rate reducing below 70% of maximum heart rate downwind. At the end of the 2nd upwind leg (inner loop being sailed) heart rate may peak at 90% of maximum heart rate with the tight reach at the end of the final run (leading to the finish) peaking at about 80% of maximum heart rate.

The physical role for the 470 helm includes:

- Upwind:**
- Hiking – generally they hike quite hard
 - Playing the main sail – quite a bit of effort involved here
 - Other controls – a bit of movement to get in and operate controls
 - Upper body movement – quite a light boat and a bit of movement is involved in getting more speed out of the boat
- Running:**
- Hoist the kite
 - A lot of steering to catch waves
 - Pumping the main (not much loading here)
 - Some body movement to induce planing
- Tight reach:**
- Hiking
 - Hoisting the kite
 - Pumping the main (high loading)

By combining the physical roles for the 470 helm with the heart rate it is clear to see that the workload upwind is greatly in excess of downwind work – running for a 470 helm is a period for active recovery.

470 Helm heart rate curve – racing in 20 knots (max HR 198 b.min⁻¹)



Physiological profile of an elite 470 male crew:

Body weight: 70-72 kg
Sum of 8 skinfolds: 35-65 mm
Body fat: 10%
Height: 1.80 m
40 second sprint performance Peak Power: 555 – 631 watts

Physiological profile of an elite 470 female crew:

Body weight: 70 kg
Sum of 8 skinfolds: 75 - 95 mm
Body fat: 22 - 24%
Height: 1.72 – 1.77
40 second sprint performance Peak Power: 373 – 414 watts

Requirements – 470 crew

Power and strength – weight training is strongly encouraged for female sailors

Aerobic fitness – the amount of recovery will depend on the ability to consume oxygen

Core strength – A crucial element for any hiking sailor - rowing should be an integral part of any good all round training plan

Specific rowing sessions can be targeted at improving power and strength and aerobic conditioning.

Heart Rate Requirement – 470 crew

For the crews of a 470 (trapezing) it is a case of a complete reversal to that of the helm in terms of the heart rate percentages where downwind heart rates are higher than upwind heart rates. This is undoubtedly due to the physical effort required in trimming the spinnaker. The effort required to trim a spinnaker can increase heart rates by about **30-40%**.

For winds in excess of 10 knots upwind heart rates are less than **70% of maximum heart rate** whereas the downwind (running) heart rates **80-85% of maximum heart rate**.

This is a complete reversal to those of the 470 helm. The crew basically has an active recovery when working upwind and is pushed hard physically downwind when trimming the spinnaker is the major physiological role. It seems that the hardest part for the crew is trimming the spinnaker when sailing on a tight reach when heart rate may reach **90% of maximum heart rate**.

The physical role for the 470 crew includes:

Upwind: Trapezing – generally quite easy
 Playing the jib – not much effort involved here
 Movement – quite a bit of movement especially in 'yellow flag' races where bouncing is allowed
 Tacking is quite hard due to the distance to cover and the speed of movement across the boat

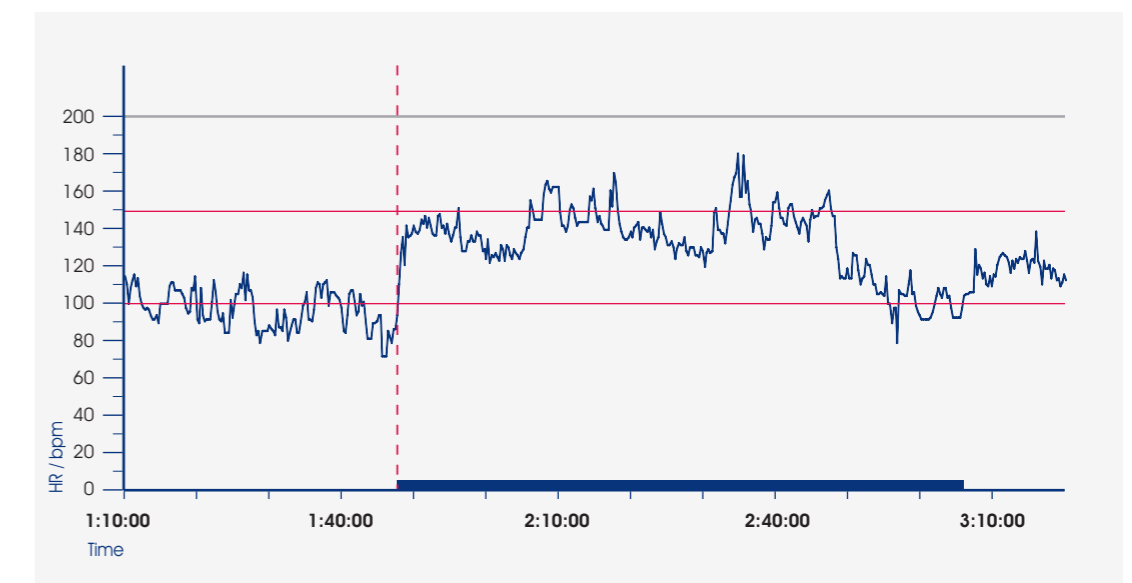
Running: Not usually trapezing when running simply just sitting on the windward side
 Pumping the spinnaker – normal to pump both the guy and the sheet at the same time, very physical in 'yellow flag' races
 Some body movement to induce planing

Tight reach: Trapezing flat out
 Trimming the spinnaker (very high loadings)

The elevated heart rates are indicative of the aerobic nature of that particular part of the course (i.e. hard upwind for the helm and hard downwind for the crew).

The fact that both helm and crew have periods of active recovery is useful and probably means the need for a really good level of aerobic fitness is reduced slightly. Muscular endurance of the hiking muscles for the helm in particular the quadriceps and the abdominal muscles are crucial to performance. Upper body strength and muscular endurance may be an issue for the helm in playing the main upwind – this may particularly be the case for small female helms of about 50 kg.

The 470 crew needs some aerobic fitness to allow recovery from trimming the kite downwind – this is particularly important as it's often the crew who call the tactics when sailing upwind. Muscular endurance is also important for trimming the kite – a typical downwind running leg could take between 6 to 8 minutes. The only time strength may be an issue is when sailing on a tight reach in strong winds – in such a case the loadings on both the guy and spinnaker sheet are large.

470 crew heart rate curve – racing in 20 knots (max HR 189 b.min⁻¹)

470 Crew & Helm Training Plan

Athlete Level 1 & 2

Week/Session	1	2	3 Short burst session
Phase 1	4 minute Test		OPTIONAL
1	2 x 12' 90" r @ 18 65-70%HRR	3 x 10' 5' r @20-22 75-80%HRR	10 x 10" 30" r @ 32-36
2	2 x 15' 90" r @ 18 65-70%HRR	3 x 10' 5' r @22-24 80-85%HRR	10 x 15" 30" r @ 32-36
3	2 x 18' 90" r @ 18 65-70%HRR	3 x 10' 5' r @24-26 80-85%HRR	10 x 20" 30" r @ 32-36
4	2 x 12' 90" r @ 18 65-70%HRR	3 x 10' 5' r @20-22 75-80%HRR	10 x 10" 30" r @ 32-36
Phase 2	4 minute Re-test		
5	2 x 15' 90" r @ 18 65-70%HRR	3 x 8' 4' r @22-24 80-85%HRR	12 x 10" 30" r @ 32-36
6	2 x 18' 90" r @ 18 65-70%HRR	3 x 8' 4' r @24-26 80-85%HRR	12 x 15" 30" r @ 32-36
7	2 x 20' 90" r @ 18 65-70%HRR	3 x 8' 5' r @26-28 85-90%HRR	12 x 20" 30" r @ 32-36
8	2 x 15' 90" r @ 18 65-70%HRR	3 x 8' 4' r @22-24 80-85%HRR	12 x 10" 30" r @ 32-36
Phase 3	4 minute Re-test		
9	2 x 18' 90" r @ 18 65-70%HRR	3 x 6' 3' r @24-26 80-85%HRR	15 x 10" 30" r @ 32-36
10	2 x 20' 90" r @ 18 65-70%HRR	3 x 6' 3' r @26-28 85-90%HRR	15 x 15" 30" r @ 32-36
11	2 x 23' 90" r @ 18 65-70%HRR	3 x 6' 3' r @28-30 90%HRR	15 x 20" 30" r @ 32-36
12	2 x 28' 90" r @ 18 65-70%HRR	3 x 6' 3' r @24-26 80-85%HRR	15 x 10" 30" r @ 32-36
Phase 4	4 minute Re-test		
13	2 x 12' 90" r @ 18 65-70%HRR	4 x 4' 3' r @24-26 85%HRR	10 x 10" 30" r @ 32-36
14	2 x 15' 90" r @ 18 65-70%HRR	4 x 4' 3' r @26-28 85-90%HRR	10 x 15" 30" r @ 32-36
15	2 x 18' 90" r @ 18 65-70%HRR	4 x 4' 3' r @28-30 90%HRR	10 x 20" 30" r @ 32-36
16	2 x 12' 90" r @ 18 65-70%HRR	4 x 4' 3' r @24-26 85%HRR	10 x 10" 30" r @ 32-36

* HRR = Heart Rate Reserve – see page 9

470 Crew & Helm Training Plan

Athlete Level 3 & 4

Week/Session	1	2	3	4 Short burst session
Phase 1	4 minute Test			OPTIONAL
1	2 x 15' 90" r @ 18 70-75%HRR	3 x 10' 5' r @ 20-22 75-80%HRR	2 x 15' 90" r @ 18 65-70%HRR	12 x 10" 30" r @ 32-36
2	2 x 18' 90" r @ 18 70-75%HRR	3 x 10' 5' r @ 22-24 80-85%HRR	2 x 18' 90" r @ 18 65-70%HRR	12 x 15" 30" r @ 32-36
3	2 x 20' 90" r @ 18 70-75%HRR	3 x 10' 5' r @ 24-26 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	12 x 20" 30" r @ 32-36
4	2 x 15' 90" r @ 18 70-75%HRR	3 x 10' 5' r @ 20-22 75-80%HRR	2 x 15' 90" r @ 18 65-70%HRR	12 x 10" 30" r @ 32-36
Phase 2	4 minute Re-test			
5	3 x 12' 90" r @ 18 70-75%HRR	3 x 8' 4' r @ 22-24 80-85%HRR	3 x 12' 90" r @ 18 65-70%HRR	15 x 10" 30" r @ 32-36
6	2 x 20' 90" r @ 18 70-75%HRR	3 x 8' 4' r @ 24-26 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	15 x 15" 30" r @ 32-36
7	2 x 23' 90" r @ 18 70-75%HRR	3 x 8' 5' r @ 26-28 85-90%HRR	2 x 23' 90" r @ 18 65-70%HRR	15 x 20" 30" r @ 32-36
8	3 x 12' 90" r @ 18 70-75%HRR	3 x 8' 4' r @ 22-24 80-85%HRR	3 x 12' 90" r @ 18 65-70%HRR	15 x 10" 30" r @ 32-36
Phase 3	4 minute Re-test			
9	2 x 20' 90" r @ 18 70-75%HRR	3 x 6' 3' r @ 24-26 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	18 x 10" 30" r @ 32-36
10	2 x 23' 90" r @ 18 70-75%HRR	3 x 6' 3' r @ 26-28 85-90%HRR	2 x 23' 90" r @ 18 65-70%HRR	18 x 15" 30" r @ 32-36
11	2 x 25' 90" r @ 18 70-75%HRR	3 x 6' 3' r @ 28-30 90%HRR	2 x 25' 90" r @ 18 65-70%HRR	18 x 20" 30" r @ 32-36
12	2 x 20' 90" r @ 18 70-75%HRR	3 x 6' 3' r @ 24-26 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	18 x 10" 30" r @ 32-36
Phase 4	4 minute Re-test			
13	2 x 15' 90" r @ 18 70-75%HRR	4 x 4' 3' r @ 24-26 85%HRR	2 x 15' 90" r @ 18 65-70%HRR	12 x 10" 30" r @ 32-36
14	2 x 18' 90" r @ 18 70-75%HRR	4 x 4' 3' r @ 26-28 85-90%HRR	2 x 18' 90" r @ 18 65-70%HRR	12 x 15" 30" r @ 32-36
15	2 x 20' 90" r @ 18 70-75%HRR	4 x 4' 3' r @ 28-30 90%HRR	2 x 20' 90" r @ 18 65-70%HRR	12 x 20" 30" r @ 32-36
16	2 x 15' 90" r @ 18 70-75%HRR	4 x 4' 3' r @ 24-26 85%HRR	2 x 15' 90" r @ 18 65-70%HRR	12 x 10" 30" r @ 32-36

* HRR = Heart Rate Reserve – see page 9

470 Crew & Helm Training Plan

Athlete Level 5

Week/Session	1	2	3	4	5 Short burst session
Phase 1	4 minute Test				OPTIONAL
1	2 x 20' 5 r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 70%HRR	3 x 10' 5' r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 70-75%HRR	15 x 10" 30" r @ 32-36
2	2 x 20' 5 r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 70%HRR	3 x 10' 5' r @ 22-24 80-85% HRR	2 x 20' 90" r @ 18 70-75%HRR	15 x 15" 30" r @ 32-36
3	3 x 10' 5 r @ 26-28 90%HRR	2 x 23' 90" r @ 18 70%HRR	3 x 10' 5' r @ 24-26 80-85%HRR	2 x 23' 90" r @ 18 70-75%HRR	15 x 20" 30" r @ 32-36
4	2 x 20' 5 r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 70%HRR	3 x 10' 5' r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 70-75%HRR	15 x 10" 30" r @ 32-36
Phase 2	4 minute Re-test				
5	2 x 20' 5 r @ 20-22 80%HRR	2 x 20' 90" r @ 18 70%HRR	3 x 8' 4' r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 70-75%HRR	18 x 10" 30" r @ 32-36
6	2 x 20' 5 r @ 22-24 80-85%HRR	2 x 23' 90" r @ 18 70%HRR	3 x 8' 4' r @ 24-26 80-85%HRR	2 x 23' 90" r @ 18 70-75%HRR	18 x 15" 30" r @ 32-36
7	3 x 10' 5 r @ 26-28 90%HRR	2 x 25' 90" r @ 18 70%HRR	3 x 8' 5' r @ 26-28 85-90%HRR	2 x 25' 90" r @ 18 70-75%HRR	18 x 20" 30" r @ 32-36
8	2 x 20' 5 r @ 20-22 80%HRR	2 x 20' 90" r @ 18 70%HRR	3 x 8' 4' r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 70-75%HRR	18 x 10" 30" r @ 32-36
Phase 3	4 minute Re-test				
9	2 x 20' 5 r @ 20-22 80%HRR	2 x 23' 90" r @ 18 70%HRR	3 x 6' 3' r @ 24-26 80-85%HRR	2 x 23' 90" r @ 18 70-75%HRR	20 x 10" 30" r @ 32-36
10	2 x 20' 5 r @ 22-24 80-85%HRR	2 x 25' 90" r @ 18 70%HRR	3 x 6' 3' r @ 26-28 85-90%HRR	2 x 25' 90" r @ 18 70-75%HRR	20 x 15" 30" r @ 32-36
11	3 x 10' 5 r @ 26-28 90%HRR	2 x 30' 90" r @ 18 70%HRR	3 x 6' 3' r @ 28-30 90%HRR	2 x 30' 90" r @ 18 70-75%HRR	20 x 20" 30" r @ 32-36
12	2 x 20' 5 r @ 20-22 80%HRR	2 x 23' 90" r @ 18 70%HRR	3 x 6' 3' r @ 24-26 80-85%HRR	2 x 23' 90" r @ 18 70-75%HRR	20 x 10" 30" r @ 32-36
Phase 4	4 minute Re-test				
13	2 x 20' 5 r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 70%HRR	4 x 4' 3' r @ 24-26 85%HRR	2 x 18' 90" r @ 18 70-75%HRR	15 x 10" 30" r @ 32-36
14	2 x 20' 5 r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 70%HRR	4 x 4' 3' r @ 26-28 85-90%HRR	2 x 20' 90" r @ 18 70-75%HRR	15 x 15" 30" r @ 32-36
15	3 x 10' 5 r @ 26-28 90%HRR	2 x 23' 90" r @ 18 70%HRR	4 x 4' 3' r @ 28-30 90%HRR	2 x 23' 90" r @ 18 70-75%HRR	15 x 20" 30" r @ 32-36
16	2 x 20' 5 r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 70%HRR	4 x 4' 3' r @ 24-26 85%HRR	2 x 18' 90" r @ 18 70-75%HRR	15 x 10" 30" r @ 32-36

* HRR = Heart Rate Reserve – see page 9





Photo: Paul Campbell James / Mark Asquith © Richard Langdon / Skandia Team GBR

4.3 Physiological Demands Of 49er Sailing

The 49er is a double handed, high performance, high tech and ultra fast skiff with twin trapeze and a large asymmetrical spinnaker. Retractable wings in slider tracks allow different wing extension. The wings extend to a maximum length of 2.75 m on each side from the centre-line of the boat, thus making the boat very wide in comparison to its length.

The sailors place their feet on the edge of the wings when trapezing and thus they have a large righting moment due to the distance off the centre line of the boat. This additional righting moment is common with most skiff boats and allows them to carry large and powerful rigs which results in skiffs being one of the fastest of all Olympic sailing classes.

The 49er skiff is relatively new on the Olympic sailing scene making its first appearance in 2000 at the Sydney Olympics. In these early days the extension of the wings used to vary according to the weight of the sailors based on a pre regatta weigh in. The light weight sailors were allowed by the rules to extend their wings further than the heavier sailors and thus, in theory, giving all the sailors a similar righting moment.

This handicapping system or weight equalization system has now been scrapped in the racing rules and all 49er skiff sailors now sail with the wings fully extended.

Technically it's an 'open' class (sailed by males and females) but in practice at Olympic level it is a male dominated class with only a few exceptions – occasionally the helm being a female.

In winds above 8-10 knots the boat requires twin trapezing. The normal course sailed is a straight upwind downwind, sometimes with a mid gate on the downwind leg - the race normally finishes with a downwind leg.

The number of laps depends on the wind conditions. A typical race length is approximately 25 minutes - it is normal to have 4 races a day and anything up to 20 races making a series.

Physiological profile of an elite 49er - Crew

Body weight: 75-80 kg (combined helm and crew approx. 148 kg)
Sum of 8 skinfolds: 35 – 80 mm
Estimated Body fat: 8-16%
Height: 1.80 – 1.88 m
40 second sprint performance Peak Power: 620 – 798 watts

Physiological profile of an elite 49er - Helm

Body weight: 68-73 kg
Sum of 8 skinfolds: 65 – 90 mm
Body fat: 12-16%
Height: 1.74 – 1.80 m
40 second sprint performance Peak Power: 420 – 706 watts

Requirements – 49er

Power and strength – hoisting the kite requires power (speed and strength)

Aerobic fitness – the amount of recovery upwind will depend on the ability to consume oxygen

Weight control – body weight varies from crew to crew. Most crew's take some effort to lose weight to avoid their combined weight going over 148kg

Agility – an important aspect of fitness, in this boat there is a need to be nimble and fast this is particularly the case due to the additional width of a skiff due to the extended wings from which the sailors trapeze

Core strength – a must for sailing - rowing should be an integral part of any good all round training plan

Specific rowing sessions can be targeted at improving power and strength, aerobic conditioning and weight control

Heart Rate Requirement 49er crew and helm

It is clear from looking at any physiological data from skiff sailing that the crew of a skiff boat works a lot harder than the helm and subsequently the physiological requirements and training regimen of the two will vary. The skiff crew tends to be the 'power-house' of the boat controlling the powerful sails whereas the helm requires fine skill in steering the boat at high speeds but does not require super-fitness.

49er skiff Crew: In winds above 8-10 knots the physical demands placed on the crew are 'high'. Downwind legs are more demanding than upwind legs and heart rate may be between **85%-90% of maximum heart rate** - this is due to the large asymmetrical spinnaker and the relative large loads associated with it.

It is normal for a skiff crew to take the mainsheet controlling the main sail when sailing upwind and thus allow the helm to concentrate on accurate steering. In increasing wind strength or in conditions with sudden gusts of wind the controlling of the mainsail is a demanding job for the crew. However, upwind heart rate is approximately **75% of maximum heart rate** – and does offer a brief recovery period for the crew in comparison to sailing downwind in similar conditions.

In lighter conditions of 4 to 8 knots the physical demands are 'low' with more focus on agility and flexibility and the art of moving around the boat without upsetting its momentum is a crucial skill.

Hoisting the spinnaker is an important part of a crew's role and takes approximately 5-7 seconds of flat out effort – a wet spinnaker or a mast with twisted halyards is much harder to hoist. Peak HR coincides with the kite hoist.

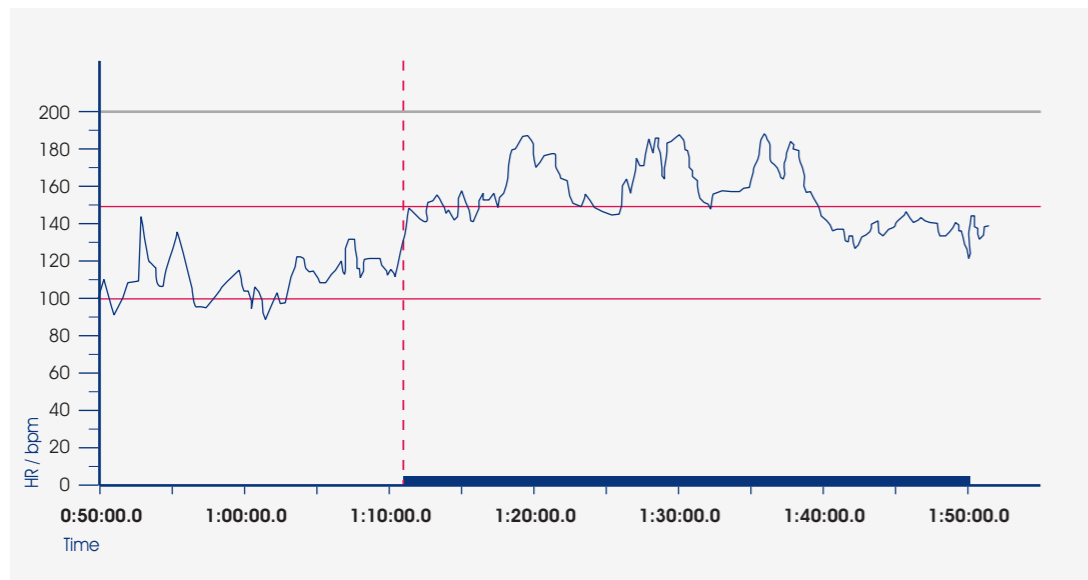
49er skiff helm: The physical demands placed on the helm are minimal when compared to the crew. This is a deliberate part of any skiff sailing partnership and allows the helm to concentrate solely on accurate steering which is critical due to the speed that skiff boats sail at. The main physical role placed on the helm is the art of moving without disturbing the steering of the boat and thus agility is really important. Being the correct body weight and being able to stay mentally alert are other important aspects placed on the helm.

In light wind conditions before full trapezing there is some physical stress placed on the helm who is constantly swinging in and out on the wing of the boat via the trapeze – this places stress on the lower body in a similar fashion as doing a high number of ‘body weight squats’ and burning in the quadriceps is quite common in such conditions.

In most conditions the crew plays the main sheet upwind then hoists the kite as quickly as possible when rounding the windward mark then playing the kite as accurately as possible downwind before a last minute drop before starting the next beat.

In moderate winds when twin wiring on the trapeze is intermittent or marginal the crew normally counteracts the changes in wind strength by coming in and then going back out on the trapeze wire whereas the helm tries to remain as static as possible on the trapeze. This can make the crew’s role quite dynamic in such marginal wiring conditions.

49er Crew: heart rate trace during racing in 15-18 knots (max heart rate 198 b.min⁻¹)



49er Crew Training Plan

Athlete Level 1 & 2

Week/Session	1	2	3 Short burst session
Phase 1	4 minute Test		OPTIONAL
1	2 x 12' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 20-22 75-80%HRR	10 x 10" 30" r @ 32-36
2	2 x 15' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 22-24 80-85%HRR	10 x 15" 30" r @ 32-36
3	2 x 18' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 24-26 80-85%HRR	10 x 20" 30" r @ 32-36
4	2 x 12' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 20-22 75-80%HRR	10 x 10" 30" r @ 32-36
Phase 2	4 minute Re-test		
5	2 x 15' 90" r @ 18 65-70%HRR	3 x 8' 4' r @ 22-24 80-85%HRR	12 x 10" 30" r @ 32-36
6	2 x 18' 90" r @ 18 65-70%HRR	3 x 8' 4' r @ 24-26 80-85%HRR	12 x 15" 30" r @ 32-36
7	2 x 20' 90" r @ 18 65-70%HRR	3 x 8' 5' r @ 26-28 85-90%HRR	12 x 20" 30" r @ 32-36
8	2 x 15' 90" r @ 18 65-70%HRR	3 x 8' 4' r @ 22-24 80-85%HRR	12 x 10" 30" r @ 32-36
Phase 3	4 minute Re-test		
9	2 x 18' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 24-26 80-85%HRR	15 x 10" 30" r @ 32-36
10	2 x 20' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 26-28 85-90%HRR	15 x 15" 30" r @ 32-36
11	2 x 23' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 28-30 90%HRR	15 x 20" 30" r @ 32-36
12	2 x 28' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 24-26 80-85%HRR	15 x 10" 30" r @ 32-36
Phase 4	4 minute Re-test		
13	2 x 12' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 24-26 85%HRR	10 x 10" 30" r @ 32-36
14	2 x 15' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 26-28 85-90%HRR	10 x 15" 30" r @ 32-36
15	2 x 18' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 28-30 90%HRR	10 x 20" 30" r @ 32-36
16	2 x 12' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 24-26 85%HRR	10 x 10" 30" r @ 32-36

* HRR = Heart Rate Reserve – see page 9

49er Helm Training Plan

Athlete Level 1 & 2

Week/Session	1	2
Phase 1	4 minute Test	
1	2 x 12' 90" r @ 18 65%HRR	2 x 15' 90" r @ 18 70%HRR
2	2 x 15' 90" r @ 18 65%HRR	2 x 18' 90" r @ 18 70%HRR
3	2 x 18' 90" r @ 18 65%HRR	2 x 20' 90" r @ 18 70%HRR
4	2 x 12' 90" r @ 18 65%HRR	2 x 15' 90" r @ 18 70%HRR
Phase 2	4 minute Re-test	
5	2 x 15' 90" r @ 18 65%HRR	3 x 12' 90" r @ 18 70%HRR
6	2 x 18' 90" r @ 18 65%HRR	2 x 20' 90" r @ 18 70%HRR
7	2 x 20' 90" r @ 18 65%HRR	2 x 23' 90" r @ 18 70%HRR
8	2 x 15' 90" r @ 18 65%HRR	3 x 12' 90" r @ 18 70%HRR
Phase 3	4 minute Re-test	
9	2 x 18' 90" r @ 18 65%HRR	2 x 20' 90" r @ 18 70%HRR
10	2 x 20' 90" r @ 18 65%HRR	2 x 23' 90" r @ 18 70%HRR
11	2 x 23' 90" r @ 18 65%HRR	2 x 25' 90" r @ 18 70%HRR
12	2 x 28' 90" r @ 18 65%HRR	2 x 20' 90" r @ 18 70%HRR
Phase 4	4 minute Re-test	
13	2 x 12' 90" r @ 18 65%HRR	2 x 15' 90" r @ 18 70%HRR
14	2 x 15' 90" r @ 18 65%HRR	2 x 18' 90" r @ 18 70%HRR
15	2 x 18' 90" r @ 18 65%HRR	2 x 20' 90" r @ 18 70%HRR
16	2 x 12' 90" r @ 18 65%HRR	2 x 15' 90" r @ 18 70%HRR

* HRR = Heart Rate Reserve – see page 9

49er Crew Training Plan

Athlete Level 3 & 4

Week/Session	1	2	3	4 Short burst session
Phase 1	4 minute Test			OPTIONAL
1	2 x 15' 90" r @ 18 70-75%HRR	3 x 10' 5" r @ 20-22 75-80%HRR	2 x 15' 90" r @ 18 65-70%HRR	12 x 10" 30" r @ 32-36
2	2 x 18' 90" r @ 18 70-75%HRR	3 x 10' 5" r @ 22-24 80-85%HRR	2 x 18' 90" r @ 18 65-70%HRR	12 x 15" 30" r @ 32-36
3	2 x 20' 90" r @ 18 70-75%HRR	3 x 10' 5" r @ 24-26 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	12 x 20" 30" r @ 32-36
4	2 x 15' 90" r @ 18 70-75%HRR	3 x 10' 5" r @ 20-22 75-80%HRR	2 x 15' 90" r @ 18 65-70%HRR	12 x 10" 30" r @ 32-36
Phase 2	4 minute Re-test			
5	3 x 12' 90" r @ 18 70-75%HRR	3 x 8' 4" r @ 22-24 80-85%HRR	3 x 12' 90" r @ 18 65-70%HRR	15 x 10" 30" r @ 32-36
6	2 x 20' 90" r @ 18 70-75%HRR	3 x 8' 4" r @ 24-26 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	15 x 15" 30" r @ 32-36
7	2 x 23' 90" r @ 18 70-75%HRR	3 x 8' 5" r @ 26-28 85-90%HRR	2 x 23' 90" r @ 18 65-70%HRR	15 x 20" 30" r @ 32-36
8	3 x 12' 90" r @ 18 70-75%HRR	3 x 8' 4" r @ 22-24 80-85%HRR	3 x 12' 90" r @ 18 65-70%HRR	15 x 10" 30" r @ 32-36
Phase 3	4 minute Re-test			
9	2 x 20' 90" r @ 18 70-75%HRR	3 x 6' 3" r @ 24-26 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	18 x 10" 30" r @ 32-36
10	2 x 23' 90" r @ 18 70-75%HRR	3 x 6' 3" r @ 26-28 85-90%HRR	2 x 23' 90" r @ 18 65-70%HRR	18 x 15" 30" r @ 32-36
11	2 x 25' 90" r @ 18 70-75%HRR	3 x 6' 3" r @ 28-30 90%HRR	2 x 25' 90" r @ 18 65-70%HRR	18 x 20" 30" r @ 32-36
12	2 x 20' 90" r @ 18 70-75%HRR	3 x 6' 3" r @ 24-26 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	18 x 10" 30" r @ 32-36
Phase 4	4 minute Re-test			
13	2 x 15' 90" r @ 18 70-75%HRR	4 x 4' 3" r @ 24-26 85%HRR	2 x 15' 90" r @ 18 65-70%HRR	12 x 10" 30" r @ 32-36
14	2 x 18' 90" r @ 18 70-75%HRR	4 x 4' 3" r @ 26-28 85-90%HRR	2 x 18' 90" r @ 18 65-70%HRR	12 x 15" 30" r @ 32-36
15	2 x 20' 90" r @ 18 70-75%HRR	4 x 4' 3" r @ 28-30 90%HRR	2 x 20' 90" r @ 18 65-70%HRR	12 x 20" 30" r @ 32-36
16	2 x 15' 90" r @ 18 70-75%HRR	4 x 4' 3" r @ 24-26 85%HRR	2 x 15' 90" r @ 18 65-70%HRR	12 x 10" 30" r @ 32-36

* HRR = Heart Rate Reserve – see page 9

49er Helm Training Plan

Athlete Level 3 & 4

Week/Session	1	2	3
Phase 1	4 minute Test		
1	2 x 15' 90" r @ 18 65-70%HRR	2 x 18' 90" r @ 18 65%HRR	2 x 15' 90" r @ 18 65-70%HRR
2	2 x 18' 90" r @ 18 65-70%HRR	2 x 20' 90" r @ 18 65%HRR	2 x 18' 90" r @ 18 65-70%HRR
3	2 x 20' 90" r @ 18 65-70%HRR	2 x 23' 90" r @ 18 65%HRR	2 x 20' 90" r @ 18 65-70%HRR
4	2 x 15' 90" r @ 18 65-70%HRR	2 x 18' 90" r @ 18 65%HRR	2 x 15' 90" r @ 18 65-70%HRR
Phase 2	4 minute Re-test		
5	3 x 12' 90" r @ 18 65-70%HRR	2 x 20' 90" r @ 18 65%HRR	3 x 12' 90" r @ 18 65-70%HRR
6	2 x 20' 90" r @ 18 65-70%HRR	2 x 23' 90" r @ 18 65%HRR	2 x 20' 90" r @ 18 65-70%HRR
7	2 x 23' 90" r @ 18 65-70%HRR	2 x 25' 90" r @ 18 65%HRR	2 x 23' 90" r @ 18 65-70%HRR
8	3 x 12' 90" r @ 18 65-70%HRR	2 x 20' 90" r @ 18 65%HRR	3 x 12' 90" r @ 18 65-70%HRR
Phase 3	4 minute Re-test		
9	2 x 20' 90" r @ 18 65-70%HRR	2 x 23' 90" r @ 18 65%HRR	2 x 20' 90" r @ 18 65-70%HRR
10	2 x 23' 90" r @ 18 65-70%HRR	2 x 25' 90" r @ 18 65%HRR	2 x 23' 90" r @ 18 65-70%HRR
11	2 x 25' 90" r @ 18 65-70%HRR	2 x 30' 90" r @ 18 65%HRR	2 x 25' 90" r @ 18 65-70%HRR
12	2 x 20' 90" r @ 18 65-70%HRR	2 x 23' 90" r @ 18 65%HRR	2 x 20' 90" r @ 18 65-70%HRR
Phase 4	4 minute Re-test		
13	2 x 15' 90" r @ 18 65-70%HRR	2 x 18' 90" r @ 18 65%HRR	2 x 15' 90" r @ 18 65-70%HRR
14	2 x 18' 90" r @ 18 65-70%HRR	2 x 20' 90" r @ 18 65%HRR	2 x 18' 90" r @ 18 65-70%HRR
15	2 x 20' 90" r @ 18 65-70%HRR	2 x 23' 90" r @ 18 65%HRR	2 x 20' 90" r @ 18 65-70%HRR
16	2 x 15' 90" r @ 18 65-70%HRR	2 x 18' 90" r @ 18 65%HRR	2 x 15' 90" r @ 18 65-70%HRR

* HRR = Heart Rate Reserve – see page 9

49er Crew Training Plan

Athlete Level 5

Week/Session	1	2	3	4	5 Short burst session
Phase 1	4 minute Test				OPTIONAL
1	2 x 20' 5 r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 70-75%HRR	15 x 10" 30" r @ 32-36
2	2 x 20' 5 r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 22-24 80-85% HRR	2 x 20' 90" r @ 18 70-75%HRR	15 x 15" 30" r @ 32-36
3	3 x 10' 5 r @ 26-28 90%HRR	2 x 23' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 24-26 80-85%HRR	2 x 23' 90" r @ 18 70-75%HRR	15 x 20" 30" r @ 32-36
4	2 x 20' 5 r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 70%HRR	3 x 10' 5' r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 70-75%HRR	15 x 10" 30" r @ 32-36
Phase 2	4 minute Re-test				
5	2 x 20' 5 r @ 20-22 80%HRR	2 x 20' 90" r @ 18 65-70%HRR	3 x 8' 4' r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 70-75%HRR	18 x 10" 30" r @ 32-36
6	2 x 20' 5 r @ 22-24 80-85%HRR	2 x 23' 90" r @ 18 65-70%HRR	3 x 8' 4' r @ 24-26 80-85%HRR	2 x 23' 90" r @ 18 70-75%HRR	18 x 15" 30" r @ 32-36
7	3 x 10' 5 r @ 26-28 90%HRR	2 x 25' 90" r @ 18 65-70%HRR	3 x 8' 5' r @ 26-28 85-90%HRR	2 x 25' 90" r @ 18 70-75%HRR	18 x 20" 30" r @ 32-36
8	2 x 20' 5 r @ 20-22 80%HRR	2 x 20' 90" r @ 18 65-70%HRR	3 x 8' 4' r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 70-75%HRR	18 x 10" 30" r @ 32-36
Phase 3	4 minute Re-test				
9	2 x 20' 5 r @ 20-22 80%HRR	2 x 23' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 24-26 80-85%HRR	2 x 23' 90" r @ 18 70-75%HRR	20 x 10" 30" r @ 32-36
10	2 x 20' 5 r @ 22-24 80-85%HRR	2 x 25' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 26-28 85-90%HRR	2 x 25' 90" r @ 18 70-75%HRR	20 x 15" 30" r @ 32-36
11	3 x 10' 5 r @ 26-28 90%HRR	2 x 30' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 28-30 90%HRR	2 x 30' 90" r @ 18 70-75%HRR	20 x 20" 30" r @ 32-36
12	2 x 20' 5 r @ 20-22 80%HRR	2 x 23' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 24-26 80-85%HRR	2 x 23' 90" r @ 18 70-75%HRR	20 x 10" 30" r @ 32-36
Phase 4	4 minute Re-test				
13	2 x 20' 5 r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 24-26 85%HRR	2 x 18' 90" r @ 18 70-75%HRR	15 x 10" 30" r @ 32-36
14	2 x 20' 5 r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 70%HRR	4 x 4' 3' r @ 26-28 85-90%HRR	2 x 20' 90" r @ 18 70-75%HRR	15 x 15" 30" r @ 32-36
15	3 x 10' 5 r @ 26-28 90%HRR	2 x 23' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 28-30 90%HRR	2 x 23' 90" r @ 18 70-75%HRR	15 x 20" 30" r @ 32-36
16	2 x 20' 5 r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 24-26 85%HRR	2 x 18' 90" r @ 18 70-75%HRR	15 x 10" 30" r @ 32-36

* HRR = Heart Rate Reserve – see page 9

49er Helm Training Plan

Athlete Level 5

Week/Session	1	2	3
Phase 1	4 minute Test		
1	2 x 18' 90" r @ 18 65-70%HRR	2 x 15' 90" r @ 18 70-75%HRR	2 x 18' 90" r @ 18 65-70%HRR
2	2 x 20' 90" r @ 18 65-70%HRR	2 x 18' 90" r @ 18 70-75%HRR	2 x 20' 90" r @ 18 65-70%HRR
3	2 x 23' 90" r @ 18 65-70%HRR	2 x 20' 90" r @ 18 70-75%HRR	2 x 23' 90" r @ 18 65-70%HRR
4	2 x 18' 90" r @ 18 65-70%HRR	2 x 15' 90" r @ 18 70-75%HRR	2 x 18' 90" r @ 18 65-70%HRR
Phase 2	4 minute Re-test		
5	2 x 20' 90" r @ 18 65-70%HRR	3 x 12' 90" r @ 18 70-75%HRR	2 x 20' 90" r @ 18 65-70%HRR
6	2 x 23' 90" r @ 18 65-70%HRR	2 x 20' 90" r @ 18 70-75%HRR	2 x 23' 90" r @ 18 65-70%HRR
7	2 x 25' 90" r @ 18 65-70%HRR	2 x 23' 90" r @ 18 70-75%HRR	2 x 25' 90" r @ 18 65-70%HRR
8	2 x 20' 90" r @ 18 65-70%HRR	3 x 12' 90" r @ 18 70-75%HRR	2 x 20' 90" r @ 18 65-70%HRR
Phase 3	4 minute Re-test		
9	2 x 23' 90" r @ 18 65-70%HRR	2 x 20' 90" r @ 18 70-75%HRR	2 x 23' 90" r @ 18 65-70%HRR
10	2 x 25' 90" r @ 18 65-70%HRR	2 x 23' 90" r @ 18 70-75%HRR	2 x 25' 90" r @ 18 65-70%HRR
11	2 x 30' 90" r @ 18 65-70%HRR	2 x 25' 90" r @ 18 70-75%HRR	2 x 30' 90" r @ 18 65-70%HRR
12	2 x 23' 90" r @ 18 65-70%HRR	2 x 20' 90" r @ 18 70-75%HRR	2 x 23' 90" r @ 18 65-70%HRR
Phase 4	4 minute Re-test		
13	2 x 18' 90" r @ 18 65-70%HRR	2 x 15' 90" r @ 18 70-75%HRR	2 x 18' 90" r @ 18 65-70%HRR
14	2 x 20' 90" r @ 18 65-70%HRR	2 x 18' 90" r @ 18 70-75%HRR	2 x 20' 90" r @ 18 65-70%HRR
15	2 x 23' 90" r @ 18 65-70%HRR	2 x 20' 90" r @ 18 70-75%HRR	2 x 23' 90" r @ 18 65-70%HRR
16	2 x 18' 90" r @ 18 65-70%HRR	2 x 15' 90" r @ 18 70-75%HRR	2 x 18' 90" r @ 18 65-70%HRR

* HRR = Heart Rate Reserve – see page 9





Photo: Leigh McMillan / Will Howden © Richard Langdon / Skandia Team GBR

4.5 Physiological Demands Of Tornado Catamaran Sailing

The Tornado catamaran is a double handed multihull and is the fastest of all the Olympic sailing classes. Despite being very different in sailing terms to the 49er skiff the physical demands placed on the sailors is very similar.

The Tornado has been revamped at various times during its existence and has been transformed from its rather lack luster days when it didn't have a spinnaker and was only a single trapeze cat to today where it is a highly sophisticated twin trapezed catamaran with a massive asymmetrical spinnaker and a state of the art carbon rig.

In similar fashion to the 49er skiff the Tornado is a very wide boat and with both the helm and crew trapezing it has a large righting moment. This allows the boat to carry large and powerful rigs which results in fast and furious sailing.

Also similar to the 49er skiff the Tornado is technically an 'open' class (sailed by males and females) but at the Olympic level it is a male dominated class with only a few exceptions - the occasional helm being a female. However, away from the Olympic scene catamarans are commonly sailed by both male and female sailors.

In winds above 8 knots the boat requires twin trapezing, especially when sailing upwind. The usual course sailed is a straight upwind and downwind course with racing normally finishing with a downwind leg. The number of laps depends on the wind conditions. A typical race length is approximately 45 to 60 minutes and it is normal to have 2 or 3 races a day and approximately 12 races making a series.

Physiological profile of an elite Tornado - Crew

Body weight: 80 kg
Sum of 8 skinfolds: 35 – 80 mm
Estimated Body fat: 8-16%
Height: 1.80 – 1.88 m
40 second sprint performance Peak Power: 479 – 728 watts

Physiological profile of an elite Tornado - Helm

Body weight: 65 -70 kg
Sum of 8 skinfolds: 40 - 60 mm
Body fat: 15%
Height: 1.72 - 1.78 m
40 second sprint performance Peak Power: 480 - 672 watts

Requirements – Tornado

Power and strength – hoisting the kite requires power (speed and strength)

Aerobic fitness – the amount of recovery upwind will depend on the ability to consume oxygen

Weight control – body weight varies from crew to crew. Most crews make some effort to lose weight and aim to weigh around 145 kg (combined helm and crew weight)

Agility – an important aspect of fitness, in this boat there is a need to be nimble and fast this is particularly the case due to the additional width of a catamaran

Core strength – a must for sailing and rowing should be an integral part of any good all round training plan

Specific rowing sessions can be targeted at improving power and strength, aerobic conditioning and weight control

Heart Rate Requirement - Tornado crew and helm

Just like the 49er skiff it is clear from looking at any physiological data from catamaran sailing that the crew works a lot harder than the helm and subsequently the physiological requirements and training regimen of the two will vary.

The catamaran crew tends to be the 'power-house' of the boat controlling the powerful sails whereas the helm requires fine skill in steering the boat at high speeds but does not require supreme fitness.

Tornado Catamaran Crew: In winds above 8 knots the physical demands placed on the crew are 'high'. Downwind legs are more demanding than upwind legs where heart rate may be between **80%-85% of maximum heart rate** - this is due to the large asymmetrical spinnaker and the relative large loads associated with it.

It is normal for most catamaran crews to take the mainsheet controlling the main sail when sailing upwind and thus allow the helm to concentrate of accurate steering. In increasing wind strengths or in conditions with sudden gusts of wind the controlling of the mainsail is a demanding job for the crew.

However, upwind heart rate is approximately **75% of maximum heart rate** – and does offer a brief recovery period for the crew in comparison to sailing downwind in similar conditions. In lighter conditions of 4 to 8 knots the physical demands are 'low' with more focus on agility and flexibility and the art of moving around the boat without upsetting its momentum is a crucial skill.

Hoisting the spinnaker is an important part of a crew's role and takes approximately 5-10 seconds of flat out effort – a wet spinnaker or a mast with twisted halyards is much harder to hoist. Peak HR coincides with the kite hoist.

Tornado Catamaran Helm: The physical demands placed on the helm are minimal when compared to the crew. This is a deliberate part of any catamaran sailing partnership and allows the helm to concentrate solely on accurate steering which is critical due to the high speed that most cats sail at.

The main physical role placed on the helm is the art of moving without disturbing the steering of the boat and thus agility is really important. Being the correct body weight and being able to stay mentally alert are other important aspects placed on the helm.

There is some strength requirement for Tornado helms as when tacking in stronger winds it is normal for the helm to take the jib. They must be able to play the jib as well as being able to un-sheet and sheet it back in before and after each tack.

In most conditions the crew plays the main sheet upwind then hoists the kite as quickly as possible when rounding the windward mark and then plays the kite as accurately as possible downwind before a last minute drop before starting the next beat.

In moderate winds when twin wiring on the trapeze is intermittent or marginal the crew normally counteracts the changes in wind strength by coming in and then going back out on the trapeze wire whereas the helm tries to remain as static as possible by either staying out on the trapeze or remain seated on the trapeze of the boat.

This marginal trapezing by the crew, where constant movements in and out on the wire can be a bit like doing repeated body weight squats can make the crew's role quite dynamic and strenuous on the muscles of the lower body.



Tornado Crew Training Plan

Athlete Level 1 & 2

Week/Session	1	2	3 Short burst session
Phase 1	4 minute Test		OPTIONAL
1	2 x 12' 90" r @ 18 65-70%HRR	3 x 10' 5' r @20-22 75-80%HRR	10 x 10" 30" r @ 32-36
2	2 x 15' 90" r @ 18 65-70%HRR	3 x 10' 5' r @22-24 80-85%HRR	10 x 15" 30" r @ 32-36
3	2 x 18' 90" r @ 18 65-70%HRR	3 x 10' 5' r @24-26 80-85%HRR	10 x 20" 30" r @ 32-36
4	2 x 12' 90" r @ 18 65-70%HRR	3 x 10' 5' r @20-22 75-80%HRR	10 x 10" 30" r @ 32-36
Phase 2	4 minute Re-test		
5	2 x 15' 90" r @ 18 65-70%HRR	3 x 8' 4' r @22-24 80-85%HRR	12 x 10" 30" r @ 32-36
6	2 x 18' 90" r @ 18 65-70%HRR	3 x 8' 4' r @24-26 80-85%HRR	12 x 15" 30" r @ 32-36
7	2 x 20' 90" r @ 18 65-70%HRR	3 x 8' 5' r @26-28 85-90%HRR	12 x 20" 30" r @ 32-36
8	2 x 15' 90" r @ 18 65-70%HRR	3 x 8' 4' r @22-24 80-85%HRR	12 x 10" 30" r @ 32-36
Phase 3	4 minute Re-test		
9	2 x 18' 90" r @ 18 65-70%HRR	3 x 6' 3' r @24-26 80-85%HRR	15 x 10" 30" r @ 32-36
10	2 x 20' 90" r @ 18 65-70%HRR	3 x 6' 3' r @26-28 85-90%HRR	15 x 15" 30" r @ 32-36
11	2 x 23' 90" r @ 18 65-70%HRR	3 x 6' 3' r @28-30 90%HRR	15 x 20" 30" r @ 32-36
12	2 x 28' 90" r @ 18 65-70%HRR	3 x 6' 3' r @24-26 80-85%HRR	15 x 10" 30" r @ 32-36
Phase 4	4 minute Re-test		
13	2 x 12' 90" r @ 18 65-70%HRR	4 x 4' 3' r @24-26 85%HRR	10 x 10" 30" r @ 32-36
14	2 x 15' 90" r @ 18 65-70%HRR	4 x 4' 3' r @26-28 85-90%HRR	10 x 15" 30" r @ 32-36
15	2 x 18' 90" r @ 18 65-70%HRR	4 x 4' 3' r @28-30 90%HRR	10 x 20" 30" r @ 32-36
16	2 x 12' 90" r @ 18 65-70%HRR	4 x 4' 3' r @24-26 85%HRR	10 x 10" 30" r @ 32-36

* HRR = Heart Rate Reserve – see page 9

Tornado Helm Training Plan

Athlete Level 1 & 2

Week/Session	1	2
Phase 1	4 minute Test	
1	2 x 12' 90" r @ 18 65%HRR	2 x 15' 90" r @ 18 70%HRR
2	2 x 15' 90" r @ 18 65%HRR	2 x 18' 90" r @ 18 70%HRR
3	2 x 18' 90" r @ 18 65%HRR	2 x 20' 90" r @ 18 70%HRR
4	2 x 12' 90" r @ 18 65%HRR	2 x 15' 90" r @ 18 70%HRR
Phase 2	4 minute Re-test	
5	2 x 15' 90" r @ 18 65%HRR	3 x 12' 90" r @ 18 70%HRR
6	2 x 18' 90" r @ 18 65%HRR	2 x 20' 90" r @ 18 70%HRR
7	2 x 20' 90" r @ 18 65%HRR	2 x 23' 90" r @ 18 70%HRR
8	2 x 15' 90" r @ 18 65%HRR	3 x 12' 90" r @ 18 70%HRR
Phase 3	4 minute Re-test	
9	2 x 18' 90" r @ 18 65%HRR	2 x 20' 90" r @ 18 70%HRR
10	2 x 20' 90" r @ 18 65%HRR	2 x 23' 90" r @ 18 70%HRR
11	2 x 23' 90" r @ 18 65%HRR	2 x 25' 90" r @ 18 70%HRR
12	2 x 28' 90" r @ 18 65%HRR	2 x 20' 90" r @ 18 70%HRR
Phase 4	4 minute Re-test	
13	2 x 12' 90" r @ 18 65%HRR	2 x 15' 90" r @ 18 70%HRR
14	2 x 15' 90" r @ 18 65%HRR	2 x 18' 90" r @ 18 70%HRR
15	2 x 18' 90" r @ 18 65%HRR	2 x 20' 90" r @ 18 70%HRR
16	2 x 12' 90" r @ 18 65%HRR	2 x 15' 90" r @ 18 70%HRR

* HRR = Heart Rate Reserve – see page 9

Tornado Crew Training Plan

Athlete Level 3 & 4

Week/Session	1	2	3	4 Short burst session
Phase 1	4 minute Test			OPTIONAL
1	2 x 15' 90" r @ 18 70-75%HRR	3 x 10' 5' r @ 20-22 75-80%HRR	2 x 15' 90" r @ 18 65-70%HRR	12 x 10" 30" r @ 32-36
2	2 x 18' 90" r @ 18 70-75%HRR	3 x 10' 5' r @ 22-24 80-85%HRR	2 x 18' 90" r @ 18 65-70%HRR	12 x 15" 30" r @ 32-36
3	2 x 20' 90" r @ 18 70-75%HRR	3 x 10' 5' r @ 24-26 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	12 x 20" 30" r @ 32-36
4	2 x 15' 90" r @ 18 70-75%HRR	3 x 10' 5' r @ 20-22 75-80%HRR	2 x 15' 90" r @ 18 65-70%HRR	12 x 10" 30" r @ 32-36
Phase 2	4 minute Re-test			
5	3 x 12' 90" r @ 18 70-75%HRR	3 x 8' 4' r @ 22-24 80-85%HRR	3 x 12' 90" r @ 18 65-70%HRR	15 x 10" 30" r @ 32-36
6	2 x 20' 90" r @ 18 70-75%HRR	3 x 8' 4' r @ 24-26 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	15 x 15" 30" r @ 32-36
7	2 x 23' 90" r @ 18 70-75%HRR	3 x 8' 5' r @ 26-28 85-90%HRR	2 x 23' 90" r @ 18 65-70%HRR	15 x 20" 30" r @ 32-36
8	3 x 12' 90" r @ 18 70-75%HRR	3 x 8' 4' r @ 22-24 80-85%HRR	3 x 12' 90" r @ 18 65-70%HRR	15 x 10" 30" r @ 32-36
Phase 3	4 minute Re-test			
9	2 x 20' 90" r @ 18 70-75%HRR	3 x 6' 3' r @ 24-26 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	18 x 10" 30" r @ 32-36
10	2 x 23' 90" r @ 18 70-75%HRR	3 x 6' 3' r @ 26-28 85-90%HRR	2 x 23' 90" r @ 18 65-70%HRR	18 x 15" 30" r @ 32-36
11	2 x 25' 90" r @ 18 70-75%HRR	3 x 6' 3' r @ 28-30 90%HRR	2 x 25' 90" r @ 18 65-70%HRR	18 x 20" 30" r @ 32-36
12	2 x 20' 90" r @ 18 70-75%HRR	3 x 6' 3' r @ 24-26 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	18 x 10" 30" r @ 32-36
Phase 4	4 minute Re-test			
13	2 x 15' 90" r @ 18 70-75%HRR	4 x 4' 3' r @ 24-26 85%HRR	2 x 15' 90" r @ 18 65-70%HRR	12 x 10" 30" r @ 32-36
14	2 x 18' 90" r @ 18 70-75%HRR	4 x 4' 3' r @ 26-28 85-90%HRR	2 x 18' 90" r @ 18 65-70%HRR	12 x 15" 30" r @ 32-36
15	2 x 20' 90" r @ 18 70-75%HRR	4 x 4' 3' r @ 28-30 90%HRR	2 x 20' 90" r @ 18 65-70%HRR	12 x 20" 30" r @ 32-36
16	2 x 15' 90" r @ 18 70-75%HRR	4 x 4' 3' r @ 24-26 85%HRR	2 x 15' 90" r @ 18 65-70%HRR	12 x 10" 30" r @ 32-36

* HRR = Heart Rate Reserve – see page 9

Tornado Helm Training Plan

Athlete Level 3 & 4

Week/Session	1	2	3
Phase 1	4 minute Test		
1	2 x 15' 90" r @ 18 65-70%HRR	2 x 18' 90" r @ 18 65%HRR	2 x 15' 90" r @ 18 65-70%HRR
2	2 x 18' 90" r @ 18 65-70%HRR	2 x 20' 90" r @ 18 65%HRR	2 x 18' 90" r @ 18 65-70%HRR
3	2 x 20' 90" r @ 18 65-70%HRR	2 x 23' 90" r @ 18 65%HRR	2 x 20' 90" r @ 18 65-70%HRR
4	2 x 15' 90" r @ 18 65-70%HRR	2 x 18' 90" r @ 18 65%HRR	2 x 15' 90" r @ 18 65-70%HRR
Phase 2	4 minute Re-test		
5	3 x 12' 90" r @ 18 65-70%HRR	2 x 20' 90" r @ 18 65%HRR	3 x 12' 90" r @ 18 65-70%HRR
6	2 x 20' 90" r @ 18 65-70%HRR	2 x 23' 90" r @ 18 65%HRR	2 x 20' 90" r @ 18 65-70%HRR
7	2 x 23' 90" r @ 18 65-70%HRR	2 x 25' 90" r @ 18 65%HRR	2 x 23' 90" r @ 18 65-70%HRR
8	3 x 12' 90" r @ 18 65-70%HRR	2 x 20' 90" r @ 18 65%HRR	3 x 12' 90" r @ 18 65-70%HRR
Phase 3	4 minute Re-test		
9	2 x 20' 90" r @ 18 65-70%HRR	2 x 23' 90" r @ 18 65%HRR	2 x 20' 90" r @ 18 65-70%HRR
10	2 x 23' 90" r @ 18 65-70%HRR	2 x 25' 90" r @ 18 65%HRR	2 x 23' 90" r @ 18 65-70%HRR
11	2 x 25' 90" r @ 18 65-70%HRR	2 x 30' 90" r @ 18 65%HRR	2 x 25' 90" r @ 18 65-70%HRR
12	2 x 20' 90" r @ 18 65-70%HRR	2 x 23' 90" r @ 18 65%HRR	2 x 20' 90" r @ 18 65-70%HRR
Phase 4	4 minute Re-test		
13	2 x 15' 90" r @ 18 65-70%HRR	2 x 18' 90" r @ 18 65%HRR	2 x 15' 90" r @ 18 65-70%HRR
14	2 x 18' 90" r @ 18 65-70%HRR	2 x 20' 90" r @ 18 65%HRR	2 x 18' 90" r @ 18 65-70%HRR
15	2 x 20' 90" r @ 18 65-70%HRR	2 x 23' 90" r @ 18 65%HRR	2 x 20' 90" r @ 18 65-70%HRR
16	2 x 15' 90" r @ 18 65-70%HRR	2 x 18' 90" r @ 18 65%HRR	2 x 15' 90" r @ 18 65-70%HRR

* HRR = Heart Rate Reserve – see page 9

Tornado Crew Training Plan

Athlete Level 5

Week/Session	1	2	3	4	5 Short burst session
Phase 1	4 minute Test				OPTIONAL
1	2 x 20' 5 r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 70-75%HRR	15 x 10" 30" r @ 32-36
2	2 x 20' 5 r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 22-24 80-85% HRR	2 x 20' 90" r @ 18 70-75%HRR	15 x 15" 30" r @ 32-36
3	3 x 10' 5 r @ 26-28 90%HRR	2 x 23' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 24-26 80-85%HRR	2 x 23' 90" r @ 18 70-75%HRR	15 x 20" 30" r @ 32-36
4	2 x 20' 5 r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 65-70%HRR	3 x 10' 5' r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 70-75%HRR	15 x 10" 30" r @ 32-36
Phase 2	4 minute Re-test				
5	2 x 20' 5 r @ 20-22 80%HRR	2 x 20' 90" r @ 18 65-70%HRR	3 x 8' 4' r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 70-75%HRR	18 x 10" 30" r @ 32-36
6	2 x 20' 5 r @ 22-24 80-85%HRR	2 x 23' 90" r @ 18 65-70%HRR	3 x 8' 4' r @ 24-26 80-85%HRR	2 x 23' 90" r @ 18 70-75%HRR	18 x 15" 30" r @ 32-36
7	3 x 10' 5 r @ 26-28 90%HRR	2 x 25' 90" r @ 18 65-70%HRR	3 x 8' 5' r @ 26-28 85-90%HRR	2 x 25' 90" r @ 18 70-75%HRR	18 x 20" 30" r @ 32-36
8	2 x 20' 5 r @ 20-22 80%HRR	2 x 20' 90" r @ 18 65-70%HRR	3 x 8' 4' r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 70-75%HRR	18 x 10" 30" r @ 32-36
Phase 3	4 minute Re-test				
9	2 x 20' 5 r @ 20-22 80%HRR	2 x 23' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 24-26 80-85%HRR	2 x 23' 90" r @ 18 70-75%HRR	20 x 10" 30" r @ 32-36
10	2 x 20' 5 r @ 22-24 80-85%HRR	2 x 25' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 26-28 85-90%HRR	2 x 25' 90" r @ 18 70-75%HRR	20 x 15" 30" r @ 32-36
11	3 x 10' 5 r @ 26-28 90%HRR	2 x 30' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 28-30 90%HRR	2 x 30' 90" r @ 18 70-75%HRR	20 x 20" 30" r @ 32-36
12	2 x 20' 5 r @ 20-22 80%HRR	2 x 23' 90" r @ 18 65-70%HRR	3 x 6' 3' r @ 24-26 80-85%HRR	2 x 23' 90" r @ 18 70-75%HRR	20 x 10" 30" r @ 32-36
Phase 4	4 minute Re-test				
13	2 x 20' 5 r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 24-26 85%HRR	2 x 18' 90" r @ 18 70-75%HRR	15 x 10" 30" r @ 32-36
14	2 x 20' 5 r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 26-28 85-90%HRR	2 x 20' 90" r @ 18 70-75%HRR	15 x 15" 30" r @ 32-36
15	3 x 10' 5 r @ 26-28 90%HRR	2 x 23' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 28-30 90%HRR	2 x 23' 90" r @ 18 70-75%HRR	15 x 20" 30" r @ 32-36
16	2 x 20' 5 r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 65-70%HRR	4 x 4' 3' r @ 24-26 85%HRR	2 x 18' 90" r @ 18 70-75%HRR	15 x 10" 30" r @ 32-36

* HRR = Heart Rate Reserve – see page 9

Tornado Helm Training Plan

Athlete Level 5

Week/Session	1	2	3
Phase 1	4 minute Test		
1	2 x 18' 90" r @ 18 65-70%HRR	2 x 15' 90" r @ 18 70-75%HRR	2 x 18' 90" r @ 18 65-70%HRR
2	2 x 20' 90" r @ 18 65-70%HRR	2 x 18' 90" r @ 18 70-75%HRR	2 x 20' 90" r @ 18 65-70%HRR
3	2 x 23' 90" r @ 18 65-70%HRR	2 x 20' 90" r @ 18 70-75%HRR	2 x 23' 90" r @ 18 65-70%HRR
4	2 x 18' 90" r @ 18 65-70%HRR	2 x 15' 90" r @ 18 70-75%HRR	2 x 18' 90" r @ 18 65-70%HRR
Phase 2	4 minute Re-test		
5	2 x 20' 90" r @ 18 65-70%HRR	3 x 12' 90" r @ 18 70-75%HRR	2 x 20' 90" r @ 18 65-70%HRR
6	2 x 23' 90" r @ 18 65-70%HRR	2 x 20' 90" r @ 18 70-75%HRR	2 x 23' 90" r @ 18 65-70%HRR
7	2 x 25' 90" r @ 18 65-70%HRR	2 x 23' 90" r @ 18 70-75%HRR	2 x 25' 90" r @ 18 65-70%HRR
8	2 x 20' 90" r @ 18 65-70%HRR	3 x 12' 90" r @ 18 70-75%HRR	2 x 20' 90" r @ 18 65-70%HRR
Phase 3	4 minute Re-test		
9	2 x 23' 90" r @ 18 65-70%HRR	2 x 20' 90" r @ 18 70-75%HRR	2 x 23' 90" r @ 18 65-70%HRR
10	2 x 25' 90" r @ 18 65-70%HRR	2 x 23' 90" r @ 18 70-75%HRR	2 x 25' 90" r @ 18 65-70%HRR
11	2 x 30' 90" r @ 18 65-70%HRR	2 x 25' 90" r @ 18 70-75%HRR	2 x 30' 90" r @ 18 65-70%HRR
12	2 x 23' 90" r @ 18 65-70%HRR	2 x 20' 90" r @ 18 70-75%HRR	2 x 23' 90" r @ 18 65-70%HRR
Phase 4	4 minute Re-test		
13	2 x 18' 90" r @ 18 65-70%HRR	2 x 15' 90" r @ 18 70-75%HRR	2 x 18' 90" r @ 18 65-70%HRR
14	2 x 20' 90" r @ 18 65-70%HRR	2 x 18' 90" r @ 18 70-75%HRR	2 x 20' 90" r @ 18 65-70%HRR
15	2 x 23' 90" r @ 18 65-70%HRR	2 x 20' 90" r @ 18 70-75%HRR	2 x 23' 90" r @ 18 65-70%HRR
16	2 x 18' 90" r @ 18 65-70%HRR	2 x 15' 90" r @ 18 70-75%HRR	2 x 18' 90" r @ 18 65-70%HRR

* HRR = Heart Rate Reserve – see page 9





Photo: Nick Dempsey © Richard Langdon / Ocean Images

4.6 Physiological Demands Of Olympic Windsurfing

The Olympic windsurfing class (Neil Pryde RSX) places the greatest physiological requirements on the sailors of all the Olympic classes. This is mainly in the form of a high aerobic element to the fitness requirements but strength and power are other factors of importance when racing at an International level.

Since its first appearance at the 1984 Olympics in Los Angeles the Olympic windsurfing class has changed a few times. The present day class is the Neil Pryde RSX which, in contrast to the traditional board is a shorter and wider board with an oversized fin as well as a daggerboard. The same board is used by males and females with the exception of the fin which is slightly smaller for females and the sail. Males use a 9.5 m² sail whereas females use an 8.5 m² sail.

A typical race length is 30 to 45 minutes and it is normal to have 2 or 3 races a day and up to 11 races making a series. In light winds they try to restrict the maximum numbers of races in any day to two, due to the increased physical demands in light winds.

The racing rules permit windsurfers to pump their sails in all wind conditions in an attempt to propel themselves forwards – this places great physiological demands on the body. Unlike all the other Olympic sailing classes this leads to an increased physiological demand in light winds.

As the wind speed increases the reliance on the pumping action is reduced. In light winds the greatest physiological demand is the start where the first 60 seconds is like a sprint closely followed in physiological terms by the downwind sailing legs where the heart rate is normally within 5 beats of the sailor's maximum.

In light wind conditions the average heart rate for the duration of the 30-45 minute race is approximately 90-95% of the sailors' maximum heart rate with the downwind legs of the racing course seeing heart rate very close to maximum values. The upwind legs of the course sees a slight dip in the heart rate of approximately 10 beats lower than the downwind legs. The physiological demands of upwind sailing are slightly easier than the downwind legs.

Physiological profile of an elite female windsurfer

Body weight: 60-62 kg
Sum of 8 skinfolds: 60 – 80 mm
Estimated Body fat: 18-22%
Height: 1.65 – 1.75 m
40 second sprint performance Peak Power: 520 – 550 watts

Physiological profile of an elite male windsurfer

Body weight: 68-74 kg
Sum of 8 skinfolds: 40 – 60 mm
Body fat: 10-15%
Height: 1.78 – 1.88 m
40 second sprint performance Peak Power: 640 – 680 watts

Requirements – Windsurfing

Aerobic fitness – The higher the oxygen uptake and the higher percentage of this that you can work at without fatiguing the better your ability to be an elite Olympic windsurfer.

Power and strength – You need to be powerful and good at sprinting activities so that you can get cleanly off the start line in all conditions but most notably in the light wind conditions.

Weight control – body weight varies amongst windsurfers but one thing they have in common is they tend to be lean as any adverse body weight (fat) has a negative effect on power to weight ratios and this is important particularly in light winds.

Core strength – a must for any windsurfer as the back undergoes substantial levels of stress whilst pumping in light winds and whilst harnessing in the stronger winds. Rowing needs to be an integral part of any good all round training plan.

Specific rowing sessions can be targeted at improving power and strength, aerobic conditioning and weight control.

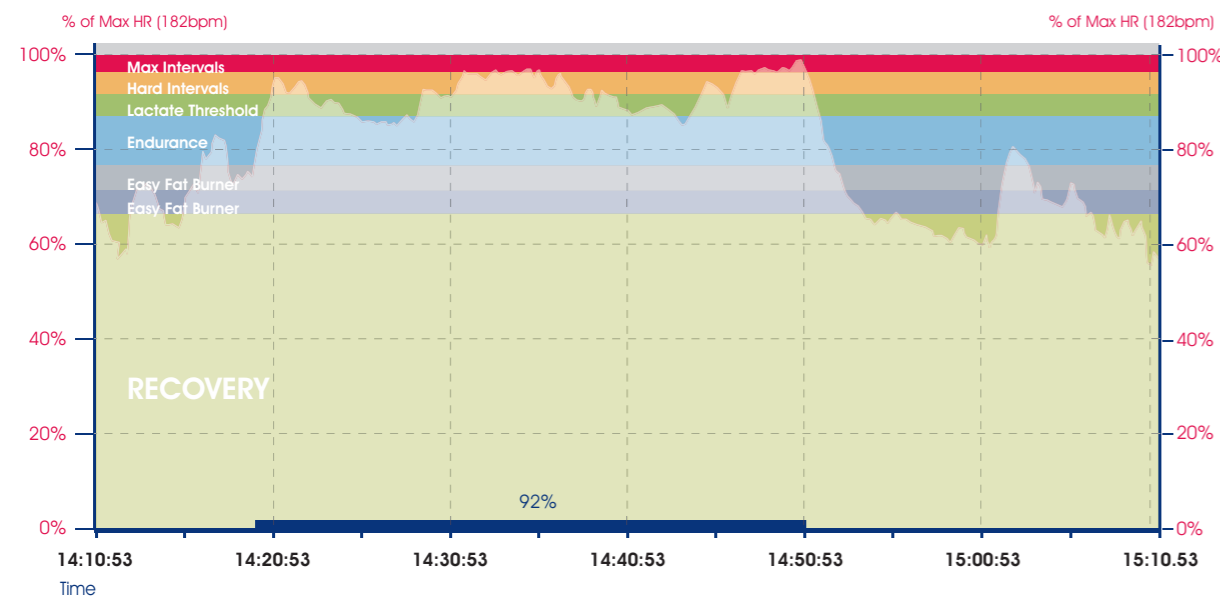
Heart Rate Requirement – Windsurfer

Pumping the sail during light wind conditions is an important part of a windsurfer's role and takes approximately 60 seconds of flat out effort at the start of a race.

In light conditions heart rates can reach **90-95% of maximum heart rate** with the downward leg close to **100% of maximum heart rate**.

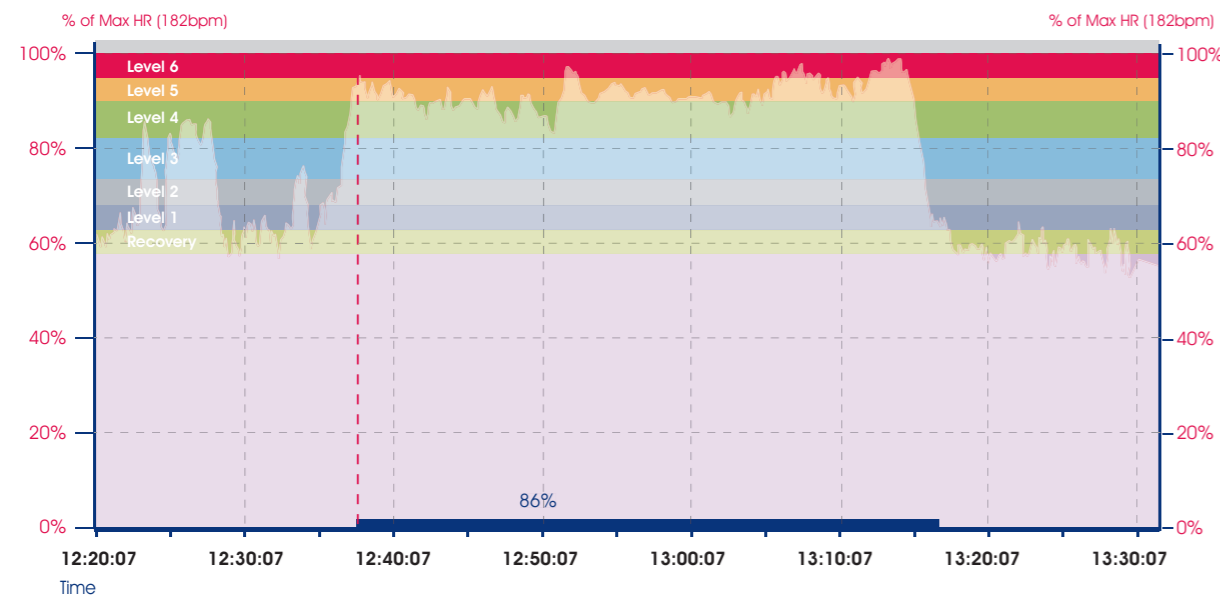
In stronger wind conditions heart rate is 10-15 beats lower at about **85% of maximum heart rate**.

Light wind (5-7 knots) windsurf race. Heart rate average 86% of Max HR, race duration 31 minutes.



In stronger winds the heart rate tends to be about 10-15 beats lower (approx. 85% of max HR) than a similar race in light wind conditions. In the heart rate trace below race the mean heart rate for the 39 minute duration of the race is 86% of maximal heart rate but it is important to note that the heart rate is much steadier (represented by a flat line) when compared to the light wind conditions.

Moderate wind (12-15 knots) windsurf race. Heart rate average 86% of Max HR, race duration 39 minutes



Windsurfer Training Plan

Athlete Level 1 & 2

Week/Session	1	2
Phase 1	4 minute Test	
1	3 x 8' 4" r @22-24 80-85%HRR	2 x 12' 90" r @ 18 65%HRR
2	3 x 8' 4" r @24-26 80-85%HRR	2 x 15' 90" r @ 18 65%HRR
3	3 x 8' 5" r @26-28 85-90%HRR	2 x 18' 90" r @ 18 65%HRR
4	3 x 8' 4" r @22-24 80-85%HRR	2 x 12' 90" r @ 18 65%HRR
Phase 2	4 minute Re-test	
5	3 x 6' 3" r @24-26 80-85%HRR	2 x 15' 90" r @ 18 65%HRR
6	3 x 6' 3" r @26-28 85-90%HRR	2 x 18' 90" r @ 18 65%HRR
7	3 x 6' 3" r @28-30 90%HRR	2 x 20' 90" r @ 18 65%HRR
8	3 x 6' 3" r @24-26 80-85%HRR	2 x 15' 90" r @ 18 65%HRR
Phase 3	4 minute Re-test	
9	4 x 4' 3" r @24-26 85%HRR	2 x 18' 90" r @ 18 65%HRR
10	4 x 4' 3" r @26-28 85-90%HRR	2 x 20' 90" r @ 18 65%HRR
11	4 x 4' 3" r @28-30 90%HRR	2 x 23' 90" r @ 18 65%HRR
12	4 x 4' 3" r @24-26 85%HRR	2 x 28' 90" r @ 18 65%HRR
Phase 4	4 minute Re-test	
13	4 x 90" 90" r @ 32-36 Max	2 x 12' 90" r @ 18 65%HRR
14	5 x 90" 90" r @ 32-36 Max	2 x 15' 90" r @ 18 65%HRR
15	6 x 90" 90" r @ 32-36 Max	2 x 18' 90" r @ 18 65%HRR
16	4 x 90" 90" r @ 32-36 Max	2 x 12' 90" r @ 18 65%HRR

* HRR = Heart Rate Reserve – see page 9

Windsurfer Training Plan

Athlete Level 3 & 4

Week/Session	1	2	3
Phase 1	4 minute Test		
1	3 x 8' 4" r @ 22-24 80-85%HRR	2 x 15' 90" r @ 18 65-70%HRR	3 x 8' 4" r @ 22-24 80-85%HRR
2	3 x 8' 4" r @ 24-26 80-85%HRR	2 x 18' 90" r @ 18 65-70%HRR	3 x 8' 4" r @ 24-26 80-85%HRR
3	3 x 8' 5" r @ 26-28 85-90%HRR	2 x 20' 90" r @ 18 65-70%HRR	3 x 8' 5" r @ 26-28 85-90%HRR
4	3 x 8' 4" r @ 22-24 80-85%HRR	2 x 15' 90" r @ 18 65-70%HRR	3 x 8' 4" r @ 22-24 80-85%HRR
Phase 2	4 minute Re-test		
5	3 x 6' 3" r @ 24-26 80-85%HRR	3 x 12' 90" r @ 18 65-70%HRR	3 x 6' 3" r @ 24-26 80-85%HRR
6	3 x 6' 3" r @ 26-28 85-90%HRR	2 x 20' 90" r @ 18 65-70%HRR	3 x 6' 3" r @ 26-28 85-90%HRR
7	3 x 6' 3" r @ 28-30 90%HRR	2 x 23' 90" r @ 18 65-70%HRR	3 x 6' 3" r @ 28-30 90%HRR
8	3 x 6' 3" r @ 24-26 80-85%HRR	3 x 12' 90" r @ 18 65-70%HRR	3 x 6' 3" r @ 24-26 80-85%HRR
Phase 3	4 minute Re-test		
9	4 x 4' 3" r @ 24-26 85%HRR	2 x 20' 90" r @ 18 65-70%HRR	4 x 4' 3" r @ 24-26 85%HRR
10	4 x 4' 3" r @ 26-28 85-90%HRR	2 x 23' 90" r @ 18 65-70%HRR	4 x 4' 3" r @ 26-28 85-90%HRR
11	4 x 4' 3" r @ 28-30 90%HRR	2 x 25' 90" r @ 18 65-70%HRR	4 x 4' 3" r @ 28-30 90%HRR
12	4 x 4' 3" r @ 24-26 85%HRR	2 x 20' 90" r @ 18 65-70%HRR	4 x 4' 3" r @ 24-26 85%HRR
Phase 4	4 minute Re-test		
13	4 x 90" 90" r @ 32-36 Max	2 x 15' 90" r @ 18 65-70%HRR	4 x 90" 90" r @ 32-36 Max
14	5 x 90" 90" r @ 32-36 Max	2 x 18' 90" r @ 18 65-70%HRR	5 x 90" 90" r @ 32-36 Max
15	6 x 90" 90" r @ 32-36 Max	2 x 20' 90" r @ 18 65-70%HRR	6 x 90" 90" r @ 32-36 Max
16	4 x 90" 90" r @ 32-36 Max	2 x 15' 90" r @ 18 65-70%HRR	4 x 90" 90" r @ 32-36 Max

* HRR = Heart Rate Reserve – see page 9

Windsurfer Training Plan

Athlete Level 5

Week/Session	1	2	3	4
Phase 1	4 minute Test			
1	2 x 20' 5" r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 65-70%HRR	3 x 8' 4" r @ 22-24 80-85%HRR	2 x 18' 90" r @ 18 70-75%HRR
2	2 x 20' 5" r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	3 x 8' 4" r @ 24-26 80-85%HRR	2 x 20' 90" r @ 18 70-75%HRR
3	3 x 10' 5" r @ 26-28 90%HRR	2 x 23' 90" r @ 18 65-70%HRR	3 x 8' 5" r @ 26-28 85-90%HRR	2 x 23' 90" r @ 18 70-75%HRR
4	2 x 20' 5" r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 65-70%HRR	3 x 8' 4" r @ 22-24 80-85%HRR	2 x 18' 90" r @ 18 70-75%HRR
Phase 2	4 minute Re-test			
5	2 x 20' 5" r @ 20-22 80%HRR	2 x 20' 90" r @ 18 65-70%HRR	3 x 6' 3" r @ 24-26 80-85%HRR	2 x 20' 90" r @ 18 70-75%HRR
6	2 x 20' 5" r @ 22-24 80-85%HRR	2 x 23' 90" r @ 18 65-70%HRR	3 x 6' 3" r @ 26-28 85-90%HRR	2 x 23' 90" r @ 18 70-75%HRR
7	3 x 10' 5" r @ 26-28 90%HRR	2 x 25' 90" r @ 18 65-70%HRR	3 x 6' 3" r @ 28-30 90%HRR	2 x 25' 90" r @ 18 70-75%HRR
8	2 x 20' 5" r @ 20-22 80%HRR	2 x 20' 90" r @ 18 65-70%HRR	3 x 6' 3" r @ 24-26 80-85%HRR	2 x 20' 90" r @ 18 70-75%HRR
Phase 3	4 minute Re-test			
9	2 x 20' 5" r @ 20-22 80%HRR	2 x 23' 90" r @ 18 65-70%HRR	4 x 4' 3" r @ 24-26 85%HRR	2 x 23' 90" r @ 18 70-75%HRR
10	2 x 20' 5" r @ 22-24 80-85%HRR	2 x 25' 90" r @ 18 65-70%HRR	4 x 4' 3" r @ 26-28 85-90%HRR	2 x 25' 90" r @ 18 70-75%HRR
11	3 x 10' 5" r @ 26-28 90%HRR	2 x 30' 90" r @ 18 65-70%HRR	4 x 4' 3" r @ 28-30 90%HRR	2 x 30' 90" r @ 18 70-75%HRR
12	2 x 20' 5" r @ 20-22 80%HRR	2 x 23' 90" r @ 18 65-70%HRR	4 x 4' 3" r @ 24-26 85%HRR	2 x 23' 90" r @ 18 70-75%HRR
Phase 4	4 minute Re-test			
13	2 x 20' 5" r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 65-70%HRR	4 x 90" 90" r @ 32-36 Max	2 x 18' 90" r @ 18 70-75%HRR
14	2 x 20' 5" r @ 22-24 80-85%HRR	2 x 20' 90" r @ 18 65-70%HRR	5 x 90" 90" r @ 32-36 Max	2 x 20' 90" r @ 18 70-75%HRR
15	3 x 10' 5" r @ 26-28 90%HRR	2 x 23' 90" r @ 18 65-70%HRR	6 x 90" 90" r @ 32-36 Max	2 x 23' 90" r @ 18 70-75%HRR
16	2 x 20' 5" r @ 20-22 75-80%HRR	2 x 18' 90" r @ 18 65-70%HRR	4 x 90" 90" r @ 32-36 Max	2 x 18' 90" r @ 18 70-75%HRR

* HRR = Heart Rate Reserve – see page 9



Section 5

Baseline Tests

5.1 Concept 2 O'Neil 4 Minute Fitness Test

Many of you may already have looked at the baseline test results for Olympic athletes and Indoor Rowing World record holders in Sections 5.3-5.5 and whilst it is always interesting to compare against Olympic athletes and Indoor Rowing World record holders a more realistic comparative test is needed. We cannot all be Olympic athletes or World record holders.

After about 10 mins familiarization with the Concept2 Indoor Rower, the O'Neil test can be carried out to get an indication of baseline fitness by simply comparing the distance covered in four minutes on the chart.

Further regular tests will indicate progress.

How to do the test:

Set the monitor on the Concept2 Indoor Rower for four minutes.

1. Row for four minutes and record the number of metres and time in minutes and seconds per 500 m. Multiply the pace per 500 m by 4 to give an equivalent 2000 m time.
2. If you are under 49 years of age look for your category in the left hand column of the O'Neil Tables below. If you are over 50 years of age compare your equivalent 2000 m time against the Fletcher Table.
3. Find your distance covered/2000 m equivalent time and check your Athlete Level from the row at the top. You can then use this Athlete Level attained to use in conjunction with the Concept 2 Interactive Training Plan www.concept2.co.uk/training/interactive.php or the specific Training Plans in section 4 of this guide.

Note: Whilst this test is suitable for people of all ages and gender for the purposes of this Guide the allocation of an Athlete Level based on an O'Neil score is restricted to Sailors aged 49 and under.

Sailors aged 50 and over should convert their distance over 4 minutes into a 2000 m time and use the Fletcher Table to determine their Athlete Level.

If you are over 50 years of age you should only attempt Level 5 training if you are an experienced indoor rower.

O'Neil Table - Female

Age Groups	Level 5	Level 4	Level 3	Level 2	Level 1
Women 19-29 Lwt	1080	1040	960	880	800
Women 19-29 Hwt	1105	1065	985	905	825
Women 30-39 Lwt	1050	1010	930	850	770
Women 30-39 Hwt	1055	1015	935	855	775
Women 40-49 Lwt	1030	990	910	830	750
Women 40-49 Hwt	1045	1005	925	845	765

O'Neil Table - Male

Age Groups	Level 5	Level 4	Level 3	Level 2	Level 1
Men 19-29 Lwt	1245	1205	1120	1040	960
Men 19-29 Hwt	1280	1240	1160	1080	1000
Men 30-39 Lwt	1225	1185	1105	1025	945
Men 30-39 Hwt	1235	1195	1105	1035	955
Men 40-49 Lwt	1210	1170	1085	1005	925
Men 40-49 Hwt	1220	1180	1100	1020	940

*Hwt = Heavyweight, Male greater than 75 kgs, Female greater than 61.5 kgs

*Lwt = Lightweight, Male less than 75 kgs, Female less than 61.5 kgs

Fletcher Table – Athlete Level from 2000 m time (minutes:seconds)

If you are over 50 years of age you can also use a 2000 m equivalent time to decide your Athlete Level using the tables below. Multiply your pace per 500 m from the 4 minute Rowing Test by 4 to obtain a 2000 m equivalent time.

Fletcher Table - Male

	Level 5	Level 4	Level 3	Level 2	Level 1
Hwt Men	5:37-6:20	6:21-6:42	6:43-6:59	7:00-8:00	8:01 +
Lwt Men	6:02-6:37	6:38-6:55	6:56-7:11	7:12-8:12	8:13 +

Fletcher Table - Female

	Level 5	Level 4	Level 3	Level 2	Level 1
Hwt Women	6:28-7:01	7:02-7:17	7:18-7:34	7:35-8:35	8:36 +
Lwt Women	6:56-7:23	7:24-7:36	7:37-7:48	7:49-8:49	8:50 +

5.2 Maximum Heart Rate Test

Remember that a maximum heart test is extremely demanding and should only be attempted by **experienced or competitive indoor rowers**. If inexperienced, despite the inaccuracy use a simple formula of 220 minus your age until fit enough to carry out a maximum heart rate test.

In order to achieve accurate results the same pre-test protocol should be carried out before you undertake any test. This should include:

- Being in good health.
- Being well rested with no heavy training sessions in the last 48 hours.
- No alcohol consumed within the last 24 hours.
- No strong coffee or tea in the previous three to four hours.

Maximum Heart Rate Test

This test has a dual purpose and can be used to determine maximum heart rate and a 2000m predicted time (2000 m is the standard racing distance for indoor rowing).

For any given load, there is an energy cost known as the metabolic equivalent, measured in METs. An increase of 25 watts on the Indoor Rower is approximately equivalent to one MET and will bring about an increase in oxygen consumption of 3.5ml/kg/min.

Model C, D, E 500m Pace/Watts Conversion Table								
500m	4:01.0	3:11.3	2:47.1	2:31.8	2:20.9	2:12.6	2:06.0	2:00.5
Watts	25	50	75	100	125	150	175	200
500m	1:55.9	1:51.9	1:48.4	1:45.3	1:42.5	1:40.0	1:37.7	1:35.6
Watts	225	250	275	300	325	350	375	400
500m	1:33.7	1:32.0	1:30.3	1:28.8	1:27.4	1:26.0	1:24.7	1:23.6
Watts	425	450	475	500	525	550	575	600

The steps used for this test are displayed in the table above in terms of Pace/500m and approximately relate to 25 watt - 1 MET increment. The test consists of five four minute pieces, each rowed at a consistent 500m pace.

The first four minute step should be set at a level which will allow you to complete the four minutes comfortably with no signs of distress. Rest for 30 seconds between each step. Note: if the monitor is set for four minutes work and 30 seconds rest, all information is stored for recording at the end of the test in the Concept 2 Indoor Rower Performance Monitor. During each step, the heart rate will rise, but should stabilize after around three minutes of each step.

Note: How to Select Steps for the Maximum Heart Rate Test

To determine the appropriate start level, you will need to know your current 2,000m time. Using Table 1, select the nearest step to your 500m split time for 2,000m.

To determine Step 1, count back six steps. After rowing 4 minutes at Step 1 move up to the next step, and so on, until Step 5 this should be performed flat out to elicit a predicted 2,000m time and your maximum heart rate.

If your 2,000m time is slower than 9:30 you must select 4:01 as your Step 1 as this is the lowest starting point for the Step Test.



The following is an example of an indoor rower who rows 2,000m in 6:40

Average 500m split = 1:40

Starting level (Step 1) is six steps back = 2:00.5

Step 2 = 1:55.9

Step 3 = 1:51.9

Step 4 = 1:48.4

Step 5 is rowed flat out to give a predicted 2,000m time and maximum heart rate

For practical purposes the pace for each step should be rounded to the nearest second.

5.3 Great Britain Olympic Sailing Team 40 Second Sprint Performance Test

The Great Britain Olympic Sailing Team use a 40 second Sprint Performance Test to assess the performance of the Sailors in the different sailing classes. The tables below summarise the peak power and pace range for the Olympic Squad Sailors.

Great Britain Olympic Sailing Team 40 second Sprint Performance Test

Male

	Laser	Finn	49er helm	49er crew	470 helm	470 crew
Peak Power(W)	703-727	803-860	642-673	685-715	577	654-667
Pace Mins:secs/500m	1:19.3 to 1:18.4	1:15.8 to 1:14.1	1:21.7 to 1:20.4	1:19.9 to 1:18.8	1:24.7	1:21.2 to 1:20.7

	Tornado helm	Tornado Crew	Windsurfer
Peak Power (W)	622-654	716	642-679
Pace Mins:secs/500m	1:22.6 to 1:21.2	1:18.8	1:21.7 to 1:20.2

Great Britain Olympic Sailing Team 40 second Sprint Performance Test

Female

	Laser Radial	470 Helm	470 Crew	Windsurfer
Peak Power (W)	529-541	486-516	585	528-540
Pace Mins:secs/500m	1:27.1 to 1:26.5	1:29.6 to 1:27.9	1:24.3	1:27.2 to 1:26.5

5.4 Great Britain Olympic Sailing Team 4 minute Rowing Test

The Great Britain Olympic Sailing Team also use a 4 minute Rowing Test as a measure of aerobic fitness. The range of distances and pace per 500 m for the various class of Sailor are summarized in the table below. Compare them with the 4 minute Concept 2 O'Neil 4 minute Fitness Test (section 5.1) and you will begin to appreciate the high fitness level of our Olympic Sailors.

Great Britain Olympic Sailing Team – 4 minute Rowing Test scores

Male

	Average Pace (min:secs/500 m)	Distance (m)
Laser hwt	1:36.5 – 1:35.0	1244 – 1263
Finn hwt	1:35.5 – 1:32.0	1256 – 1304
470 helm lwt	1:47.0 – 1:45.5	1121 – 1137
470 crew lwt	1:41.0 – 1:40.5	1188 – 1194
49er helm lwt	1:44.0 – 1:42.0	1154 – 1176
49er crew hwt/lwt	1:39.5 – 1:36.0	1206 – 1250
Windsurfer lwt	1:36.5 – 1:33.3	1244 – 1286

Great Britain Olympic Sailing Team – 4 minute Rowing Test scores

Female

	Average Pace (min:secs/500 m)	Distance (m)
Laser Radial hwt	1:46.0 – 1:45.5	1132 – 1138
470 helm lwt	1:52.0 – 1:49.0	1071 – 1101
470 crew hwt	1:44.9	1143
Windsurfer lwt	1:45.5 – 1:44.9	1137 – 1143

5.5 Indoor Rowing 2000m World Records Distance In 4 Minutes

You could also compare against the 2000 m (standard race distance) World records. Bear in mind the 4 minute distance shown is a straight conversion of the speed over 2000 m. In a shorter 4 minute row these World record holders will cover an even greater distance.

With this chart you can compare your performance against the best in your age group. Indoor rowing is split into weight categories a lightweight is less than 75 kgs for men and less than 61.5 kgs for women.

Men			Women		
Age	Time	Distance in 4 minutes	Age	Time	Distance in 4 minutes
19-29 Lwt	06:02.2	1325	19-29 Lwt	06:57.0	1151
19-29	05:38.3	1419	19-29	06:28.4	1236
30-39 Lwt	06:06.4	1310	30-39 Lwt	06:56.7	1152
30-39	05:36.6	1426	30-39	06:28.8	1235
40-49 Lwt	06:18.2	1269	40-49 Lwt	07:09.6	1117
40-49	05:57.5	1343	40-49	06:48.2	1176
50-54 Lwt	06:25.8	1244	50-54 Lwt	07:22.6	1085
50-54	06:07.7	1305	50-54	07:06.6	1125
55-59 Lwt	06:38.1	1205	55-59 Lwt	07:33.4	1059
55-59	06:20.9	1260	55-59	07:23.7	1082
60-64 Lwt	06:42.5	1192	60-64 Lwt	07:48.6	1024
60-64	06:23.7	1251	60-64	07:31.0	1064
65-69 Lwt	07:01.5	1139	65-69 Lwt	08:00.0	1000
65-69	06:46.9	1179	65-69	07:53.4	1014
70-74 Lwt	07:13.4	1108	70-74 Lwt	08:43.0	918
70-74	07:02.6	1136	70-74	08:26.7	947
75-79 Lwt	07:25.3	1078	75-79 Lwt	09:13.1	868
75-79	07:22.3	1085	75-79	08:54.0	899
80-84 Lwt	07:42.0	1039	80-84 Lwt	10:04.3	794
80-84	07:45.5	1031	80-84	8:54.8	898
85-89 Lwt	09:22.0	854	85-89 Lwt	10:25.2	768
85-89	08:55.9	861	85-89	no record	
90-94 Lwt	09:25.8	848	90-95 Lwt	12:07.5	660
90-94	11:01.9	725	90-94	no record	
95-99 Lwt	10:28.1	764	95-99 Lwt	no record	
95-99	no record		95-99	no record	



Photo: The demands of Tornado Catamaran Sailing © Richard Langdon / Skandia Team GBR

Section 6 Pace Guide

Pace per 500m mins:secs

4 minute test distance (m)	2000 m time/stroke rate	18	20-22	22-24	24-26	26-28	28-30
1333	6:00	1:50.0	1:47.0 – 1:44.0	1:44.0 – 1:41.5	1:41.5 – 1:39.0	1:39.0 – 1:37.0	1:37.0 – 1:33.5
1319	6:04	1:51.0	1:48.0 – 1:45.0	1:45.0 – 1:42.5	1:42.5 – 1:40.0	1:40.0 – 1:38.0	1:38.0 – 1:34.5
1304	6:08	1:52.0	1:49.0 – 1:46.0	1:46.0 – 1:43.5	1:43.5 – 1:41.5	1:41.5 – 1:39.0	1:39.0 – 1:35.5
1290	6:12	1:53.5	1:50.5 – 1:47.5	1:47.5 – 1:44.5	1:44.5 – 1:42.5	1:42.5 – 1:40.0	1:40.0 – 1:36.5
1277	6:16	1:54.5	1:51.5 – 1:48.5	1:48.5 – 1:46.0	1:46.0 – 1:43.5	1:43.5 – 1:41.0	1:41.0 – 1:37.5
1263	6:20	1:55.5	1:52.5 – 1:50.0	1:50.0 – 1:47.0	1:47.0 – 1:44.5	1:44.5 – 1:42.5	1:42.5 – 1:38.5
1250	6:24	1:57.0	1:54.0 – 1:51.0	1:51.0 – 1:48.0	1:48.0 – 1:46.5	1:46.5 – 1:43.5	1:43.5 – 1:39.5
1237	6:28	1:58.0	1:55.0 – 1:52.0	1:52.0 – 1:49.0	1:49.0 – 1:47.0	1:47.0 – 1:44.5	1:44.5 – 1:40.5
1224	6:32	1:59.0	1:56.0 – 1:53.0	1:53.0 – 1:50.5	1:50.5 – 1:48.0	1:48.0 – 1:45.5	1:45.5 – 1:42.0
1212	6:36	2:00.5	1:57.5 – 1:54.0	1:54.0 – 1:51.5	1:51.5 – 1:49.0	1:49.0 – 1:46.5	1:46.5 – 1:43.0
1200	6:40	2:01.5	1:58.5 – 1:55.5	1:55.5 – 1:52.5	1:52.5 – 1:50.0	1:50.0 – 1:47.5	1:47.5 – 1:44.0
1188	6:44	2:03.0	2:00.0 – 1:56.5	1:56.5 – 1:54.0	1:54.0 – 1:51.0	1:51.0 – 1:48.5	1:48.5 – 1:45.0
1176	6:48	2:04.0	2:01.0 – 1:58.0	1:58.0 – 1:55.0	1:55.0 – 1:52.0	1:52.0 – 1:50.0	1:50.0 – 1:46.0
1165	6:52	2:05.0	2:02.0 – 1:59.0	1:59.0 – 1:56.0	1:56.0 – 1:53.5	1:53.5 – 1:51.0	1:51.0 – 1:47.0
1154	6:56	2:06.5	2:03.5 – 2:00.0	2:00.0 – 1:57.0	1:57.0 – 1:54.5	1:54.5 – 1:52.0	1:52.0 – 1:48.0
1143	7:00	2:07.5	2:04.5 – 2:01.0	2:01.0 – 1:58.5	1:58.5 – 1:55.5	1:55.5 – 1:53.0	1:53.0 – 1:49.0
1132	7:04	2:09.5	2:06.0 – 2:02.5	2:02.5 – 1:59.5	1:59.5 – 1:56.5	1:56.5 – 1:54.0	1:54.0 – 1:50.0
1121	7:08	2:10.0	2:07.0 – 2:03.5	2:03.5 – 2:00.5	2:00.5 – 1:58.0	1:58.0 – 1:55.0	1:55.0 – 1:51.0
1111	7:12	2:11.0	2:08.0 – 2:04.5	2:04.5 – 2:01.5	2:01.5 – 1:59.0	1:59.0 – 1:56.5	1:56.5 – 1:52.0
1101	7:16	2:12.0	2:09.0 – 2:06.0	2:06.0 – 2:03.0	2:03.0 – 2:00.0	2:00.0 – 1:57.5	1:57.5 – 1:53.0
1091	7:20	2:13.5	2:10.5 – 2:07.0	2:07.0 – 2:04.0	2:04.0 – 2:01.0	2:01.0 – 1:58.5	1:58.5 – 1:54.0
1081	7:24	2:14.5	2:11.5 – 2:08.0	2:08.0 – 2:05.0	2:05.0 – 2:02.0	2:02.0 – 1:59.5	1:59.5 – 1:55.0
1071	7:28	2:16.0	2:13.0 – 2:09.5	2:09.5 – 2:06.0	2:06.0 – 2:03.2	2:03.0 – 2:00.5	2:00.5 – 1:56.0
1062	7:32	2:17.0	2:14.0 – 2:10.5	2:10.5 – 2:07.5	2:07.5 – 2:04.5	2:04.5 – 2:01.5	2:01.5 – 1:57.0
1053	7:36	2:18.0	2:15.0 – 2:11.5	2:11.5 – 2:08.5	2:08.5 – 2:05.5	2:05.5 – 2:03.0	2:03.0 – 1:58.0
1043	7:40	2:19.5	2:16.5 – 2:13.0	2:13.0 – 2:09.5	2:09.5 – 2:06.5	2:06.5 – 2:04.0	2:04.0 – 1:59.0
1034	7:44	2:20.5	2:17.5 – 2:14.0	2:14.0 – 2:10.5	2:10.5 – 2:07.5	2:07.5 – 2:05.0	2:05.0 – 2:00.0
1026	7:48	2:21.5	2:18.5 – 2:15.0	2:15.0 – 2:12.0	2:12.0 – 2:08.5	2:08.5 – 2:06.0	2:06.0 – 2:01.0
1017	7:52	2:23.0	2:20.0 – 2:16.0	2:16.0 – 2:13.0	2:13.0 – 2:10.0	2:10.0 – 2:07.0	2:07.0 – 2:02.0
1008	7:56	2:24.0	2:21.0 – 2:17.5	2:17.5 – 2:14.0	2:14.0 – 2:11.0	2:11.0 – 2:08.0	2:08.0 – 2:03.0
1000	8:00	2:25.0	2:22.0 – 2:18.5	2:18.5 – 2:15.0	2:15.0 – 2:12.0	2:12.0 – 2:09.0	2:09.0 – 2:04.0

4 minute test distance (m)	2000 m time/stroke rate	18	20-22	22-24	24-26	26-28	28-30
992	8:04	2:26.0	2:22.0 – 2:19.0	2:18.0 – 2:15.0	2:15.0 – 2:12.0	2:13.0 – 2:10.0	2:10.0 – 2:05.0
984	8:08	2:27.0	2:23.0 – 2:20.0	2:19.0 – 2:16.0	2:16.0 – 2:13.0	2:14.0 – 2:11.0	2:11.0 – 2:06.0
976	8:12	2:28.0	2:24.0 – 2:21.0	2:20.0 – 2:17.0	2:17.0 – 2:14.0	2:15.0 – 2:12.0	2:12.0 – 2:07.0
968	8:16	2:29.0	2:25.0 – 2:22.0	2:21.0 – 2:18.0	2:18.0 – 2:15.0	2:16.0 – 2:13.0	2:13.0 – 2:08.0
960	8:20	2:30.0	2:26.0 – 2:23.0	2:22.0 – 2:19.0	2:19.0 – 2:16.0	2:17.0 – 2:14.0	2:14.0 – 2:09.0
952	8:24	2:31.0	2:27.0 – 2:24.0	2:23.0 – 2:20.0	2:20.0 – 2:17.0	2:18.0 – 2:15.0	2:15.0 – 2:10.0
945	8:28	2:32.0	2:28.0 – 2:25.0	2:24.0 – 2:21.0	2:21.0 – 2:18.0	2:19.0 – 2:16.0	2:16.0 – 2:11.0
938	8:32	2:33.0	2:29.0 – 2:26.0	2:25.0 – 2:22.0	2:22.0 – 2:19.0	2:20.0 – 2:17.0	2:17.0 – 2:12.0
930	8:36	2:34.0	2:30.0 – 2:27.0	2:26.0 – 2:23.0	2:23.0 – 2:20.0	2:21.0 – 2:18.0	2:18.0 – 2:13.0
923	8:40	2:35.0	2:31.0 – 2:28.0	2:27.0 – 2:24.0	2:24.0 – 2:21.0	2:22.0 – 2:19.0	2:19.0 – 2:14.0
916	8:44	2:36.0	2:32.0 – 2:29.0	2:28.0 – 2:25.0	2:25.0 – 2:22.0	2:23.0 – 2:20.0	2:20.0 – 2:15.0
909	8:48	2:37.0	2:33.0 – 2:30.0	2:29.0 – 2:26.0	2:26.0 – 2:23.0	2:24.0 – 2:21.0	2:21.0 – 2:16.0
902	8:52	2:38.0	2:34.0 – 2:31.0	2:30.0 – 2:27.0	2:27.0 – 2:24.0	2:25.0 – 2:22.0	2:22.0 – 2:17.0
896	8:56	2:39.0	2:35.0 – 2:32.0	2:31.0 – 2:28.0	2:28.0 – 2:25.0	2:26.0 – 2:23.0	2:23.0 – 2:18.0
889	9:00	2:40.0	2:36.0 – 2:33.0	2:32.0 – 2:29.0	2:29.0 – 2:26.0	2:27.0 – 2:24.0	2:24.0 – 2:19.0
882	9:04	2:41.0	2:37.0 – 2:34.0	2:33.0 – 2:30.0	2:30.0 – 2:27.0	2:28.0 – 2:25.0	2:25.0 – 2:20.0
876	9:08	2:42.0	2:38.0 – 2:35.0	2:34.0 – 2:31.0	2:31.0 – 2:28.0	2:29.0 – 2:26.0	2:26.0 – 2:21.0
870	9:12	2:43.0	2:39.0 – 2:36.0	2:35.0 – 2:32.0	2:32.0 – 2:29.0	2:30.0 – 2:27.0	2:27.0 – 2:22.0
863	9:16	2:44.0	2:40.0 – 2:37.0	2:36.0 – 2:33.0	2:33.0 – 2:30.0	2:31.0 – 2:28.0	2:28.0 – 2:23.0
857	9:20	2:45.0	2:41.0 – 2:38.0	2:37.0 – 2:34.0	2:34.0 – 2:31.0	2:32.0 – 2:29.0	2:29.0 – 2:24.0
851	9:24	2:46.0	2:42.0 – 2:39.0	2:38.0 – 2:35.0	2:35.0 – 2:32.0	2:33.0 – 2:30.0	2:30.0 – 2:25.0
845	9:28	2:47.0	2:43.0 – 2:40.0	2:39.0 – 2:36.0	2:36.0 – 2:33.0	2:34.0 – 2:31.0	2:31.0 – 2:26.0
839	9:32	2:48.0	2:44.0 – 2:41.0	2:40.0 – 2:37.0	2:37.0 – 2:34.0	2:35.0 – 2:32.0	2:32.0 – 2:27.0
833	9:36	2:49.0	2:45.0 – 2:42.0	2:41.0 – 2:38.0	2:38.0 – 2:35.0	2:36.0 – 2:33.0	2:33.0 – 2:28.0
828	9:40	2:50.0	2:46.0 – 2:43.0	2:42.0 – 2:39.0	2:39.0 – 2:36.0	2:37.0 – 2:34.0	2:34.0 – 2:29.0
822	9:44	2:51.0	2:47.0 – 2:44.0	2:43.0 – 2:40.0	2:40.0 – 2:37.0	2:38.0 – 2:35.0	2:35.0 – 2:30.0
816	9:48	2:52.0	2:48.0 – 2:45.0	2:44.0 – 2:41.0	2:41.0 – 2:38.0	2:39.0 – 2:36.0	2:36.0 – 2:31.0
811	9:52	2:53.0	2:49.0 – 2:46.0	2:45.0 – 2:42.0	2:42.0 – 2:39.0	2:40.0 – 2:37.0	2:37.0 – 2:32.0
805	9:56	2:54.0	2:50.0 – 2:47.0	2:46.0 – 2:43.0	2:43.0 – 2:40.0	2:41.0 – 2:38.0	2:38.0 – 2:33.0
800	10:00	2:55.0	2:51.0 – 2:48.0	2:47.0 – 2:44.0	2:44.0 – 2:41.0	2:42.0 – 2:39.0	2:39.0 – 2:34.0

