Basic Rigging Principles

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The aim of rigging is to maximise the efficiency of the rower's body in moving the boat as quickly as possible. The efficiency of the human body is the ratio of the energy that is produced in useful work to the total energy consumed by a rower.

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Muscles do not produce the same amount of power throughout their contraction and there is a peak power point during the range of movement. According to Hill's Curve, this point of maximum efficiency occurs when the load allows the muscle to contract at 30% of maximum contraction velocity. We try to achieve this through the gearing however in reality gearing is achieved by either shortening the stroke length of reducing the stroke rate.

The downside of this is that following the principles laid out by Hill's research, dropping the rate has a double negative effect, less strokes and less power per stroke. The principle aim of gearing is to keep the stroke rate as close as possible to that which generates maximum power.

> The aims of rigging is to co-ordinate the most efficient part of the rowing stroke with the most efficient position of the body. The economical use of muscular energy requires balance and control that will also reduce the risk of stress on the tissues that inevitably lead to injury.

Research in industry has established that significant improvements in efficiency can be achieved by changing the size and shape of tools. For example, varying the height of workbenches to explore muscular strength in the most effective way can reduce fatigue and the number of calories required to achieve a given task.

The same is true for rowing which is why WINTECH Racing's research and development department have been working for many years on a diverse range of equipment sizes to suit every athlete.

Rigging

In rowing rigging is a generic term used to cover both gearing and the rig. Strictly speaking rigging applies to the type of boat and oars while gearing is the arrangement to match the load to the muscular efficiency of the athlete.

There is no such thing as a universal blade length, spoon size, spoon shape or span that is right for everyone and most club rowers are not set up to the optimum. This booklet is part of Wintech customer care policy which include a range of products to address these issues.

Rigging tables

When you look at international rigging tables, the variation is quite small. This should not be interpreted as being ideal for all but can be explained by the fact that crews at an international level will have differences in their height, weight and power selected out leaving the ideal athletes. National teams do not reflect the population at large but a very narrow spectrum, if the crews you are coaching fall into this range then it's fine to refer to these tables as a guideline.

To gain the maximum efficiency from a rower the gearing must be specific to the individual. In a club situation with shared equipment this can be difficult if not impossible. However, by explaining the principles in the set up the reader may be able to determine whether the equipment in the club, is suitable for most of the members. Also, some recent developments, especially easily adjustable oar lengths, have made changing gearing much simpler.

Adjustments

If you accept that adjusting the position of the rower with respect to the work and varying the size of equipment used can have a positive effect on the speed of the boat, the next step is to consider the options for adjustment.

All adjustments are in effect variations in the position of the rower vertically to the water, and horizontally to the pin (or face of the work). Placing the rower in the correct position is the first and most important step.

Vertical adjustments

As most of the power which moves the boat is derived from the legs, the water line should be equidistant between the lowest point of the heel and the lowest part of the seat. This will ensure that the leg drive is as close as possible to the waterline.

The range from the lowest part of the seat to the lowest part of the heel should be 14-18cm. The water line should fall 7-9cm below the seat and 7-9cm above the heel (see Fig 1).

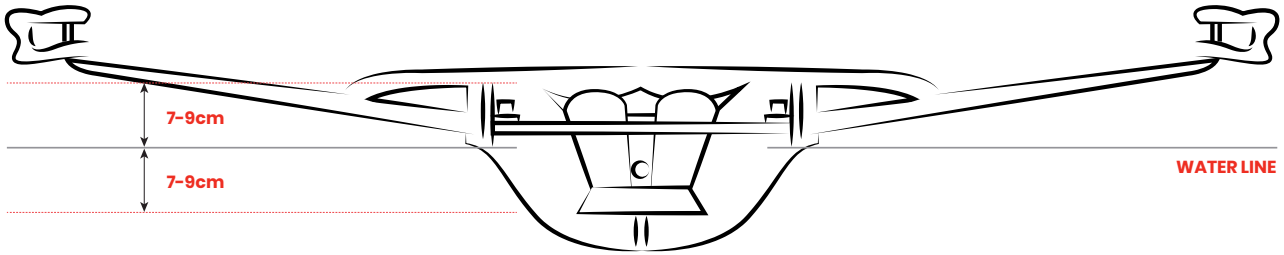
This measurement should be taken with the rower sitting at the backstop position. A sculler would be set at the lower end whilst rowers in an eight would be set higher. This measurement is quite critical. If the rower is set too high above the water, then the boat will be difficult to balance. Without balance, there is no control and without control you cannot use muscular energy efficiently.

The height of the swivel above the water line, although important, is not as critical as the height of the athlete above the water line. It has to be flexible to present the spoon of different length oars at the correct angle to the water, whilst presenting the handle at the correct height to the oarsman.

Only when this position is established do measurements within the boat have any relevance. The height of the seat below the swivel will be about the same as the height of the heel below the seat.

On modern boats, there are several adjustments you can make that affect the vertical position of the athlete.

Fig 1



Where should you start?

STEP 1

Place the crew in the boat and measure where the water line is. If the crew is too high or too low then change the bearers under the seat pan that carry the wheels until the crew are at the correct height.

STEP 2

Measure the sill of the swivel above the water line then adjust the height so that it presents the handle to the oarsman at the correct height.

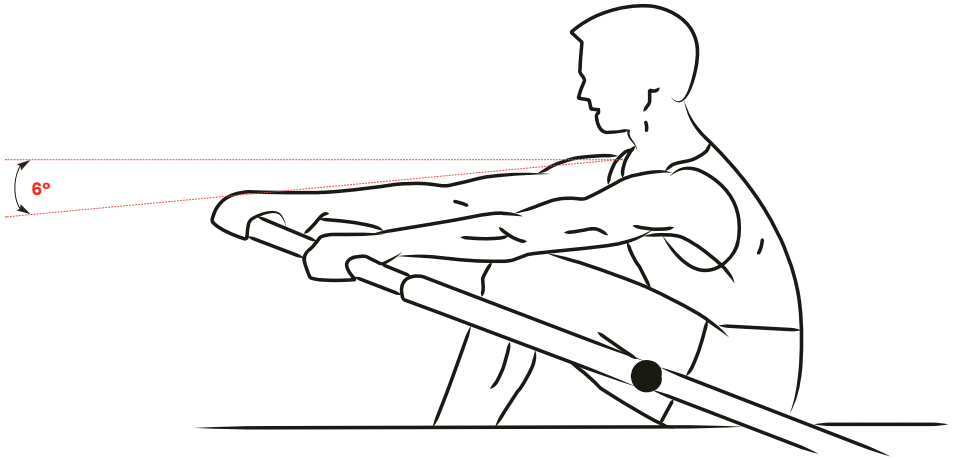
WHAT SHOULD THIS BE?

With the rower in the forward position and spoon fully covered, the arms should be in the range of horizontal to sloping down 6 degrees, (See Fig 2) with only the spoon in the water.

The final vertical adjustment is to the stretcher, which moves in two directions. The height of the stretcher can be changed also the angle or rake. For athletes with poor ankle and hamstring flexibility, these adjustments can make the rowing position more comfortable.

However, the range of adjustment is relatively small and therefore it is difficult to rig around this problem. It is far better to tackle the original problem and work on improvements in flexibility.

Fig 2



Horizontal adjustment

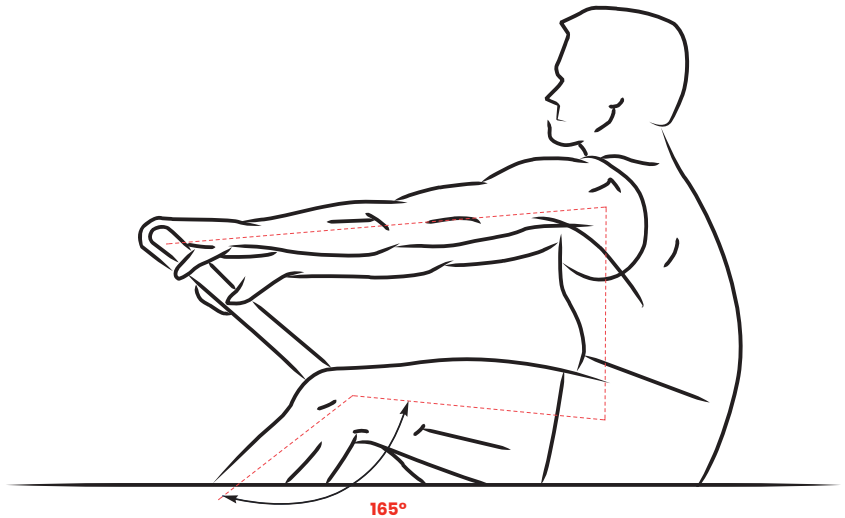
Adjust the athlete in the horizontal position with respect to the vertical side of the swivel closest to the pin, known as the face of the work. This is achieved by the placement of the foot stretcher.

The rower will be in the correct horizontal position when at three quarters of the slide (a quarter off the back stop), with the back upright and the arms straight, the oar is at right angles.

A force applied to the spoon and transferred to the boat via the swivel to the pin moves the boat. Maximum force is applied to the pin at 90 degrees.

Using the body muscle to maximum efficiency means that at this point, the angle of the thigh to the shin. (knee angle) should be 165 degrees (approx. quarter slide), which is the strongest position of the legs (see Fig 3).

Fig 3



Stroke length

The first biomechanical principle of rowing is that the athlete should row a long stroke. British Rowing manuals determine the length as 90 degrees for rowing and 110 degrees for sculling. It also suggests that the proportion of the stroke length before and after the pin should be in the region 60-40. This would mean in a rowing boat taking the catch at 55 degrees before the pin and finishing at 35 degrees behind the pin. In a single it would be 70 degrees at the catch and 40 degrees at the finish. Taking as an example a blade length of 374 cm; the span is set at 84cm and the inboard is 116cm.

From Pythagoras the distance the handle must travel forms the hypotenuse of a right-angled triangle with the inboard at the catch and finish forming the other two sides. In the example given this means the handle at the end must move 164cm. A simple way to check the range of movement is on an indoor rowing machine.

To compare with the erg, the stroke length in the boat must be derived at the middle of the handle, so the actual inboard is 115 – 15 = 100cm, which gives 141cm stroke length using this method. This presents most coaches with their first problem, as many club rowers cannot rower this long. Most club rowers move the handle at the end in the region 140-150cm which is a stroke length around 120cms. What is surprising is the difference in the range of movement by members of the same crew who are all set up on the same rig in the boat.

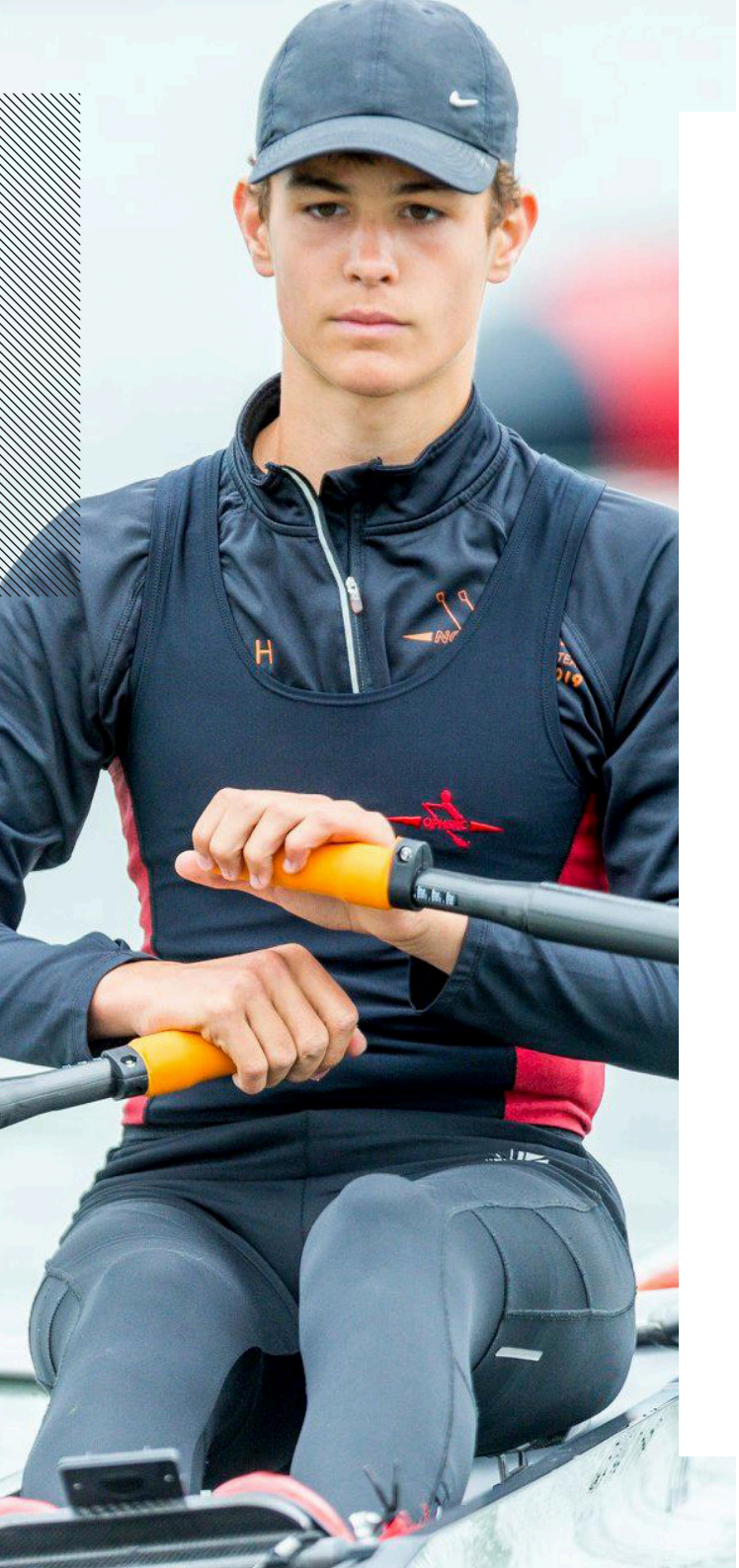
This can only lead to one outcome; the whole crew row to the same length as the shortest rowers. Surprisingly, this is still common in top crews. Lack of flexibility will affect stroke length but rowers are notoriously bad at working on their flexibility. This is difficult to understand, as flexibility is an area where great improvements can be made and is as important as any other aspect of training.

Stature will also affect stroke length. One thing you do not want to do is to achieve a longer stroke by getting the rowers to over reach. This will lead to the rower getting into a weak position and increases the risk of injury. Shorter rowers need to keep their body position the same as their taller colleagues as this is biomechanically the most efficient.

The rigging needs to be scaled down to allow the longest stroke possible within the efficient range of movement of the athlete. This is achieved in one of two ways, reduce the stroke length in degrees or reduce the oar length and span and keep the angles the same. Both options will shorten the stroke length but following Hill's principles, maintaining stroke rate is more important.

The key is whether the athlete can develop a good rhythm. In the conversion from Macon to Big Blades, the inboard and span remain the same but the outboard oar length is reduced by 10 cm. The spoon area had been increased and had a more efficient shape, increasing the load on the athlete. By reducing the outboard oar length to give the athlete a mechanical advantage, meant that the rhythm stayed the same so there was no dramatic change in the feel to the oarsman.

The effect was to reduce the stroke length at the blade by about 10cm, however there was no apparent loss of boat speed. The stroke length is determined by the placement of the pin with respect to the centre line of the boat, overall oar length and the ratio of inboard to outboard (See Fig 4).



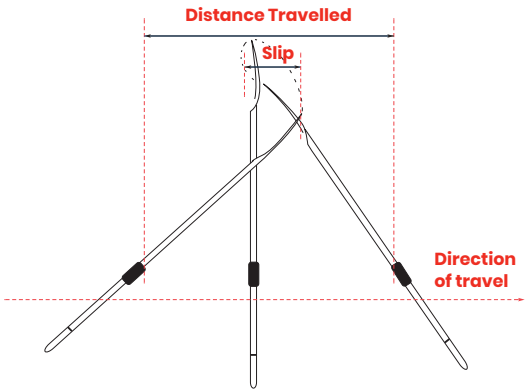
The stroke length is measured at the tip of the spoon will be equal to the distance the athlete can move the handle x the ratio of the outboard to inboard. For example; if the athlete can move the end of the handle 150cm, the blade length is 374cm with 116cm to the pin inboard and 258cm to the pin outboard.

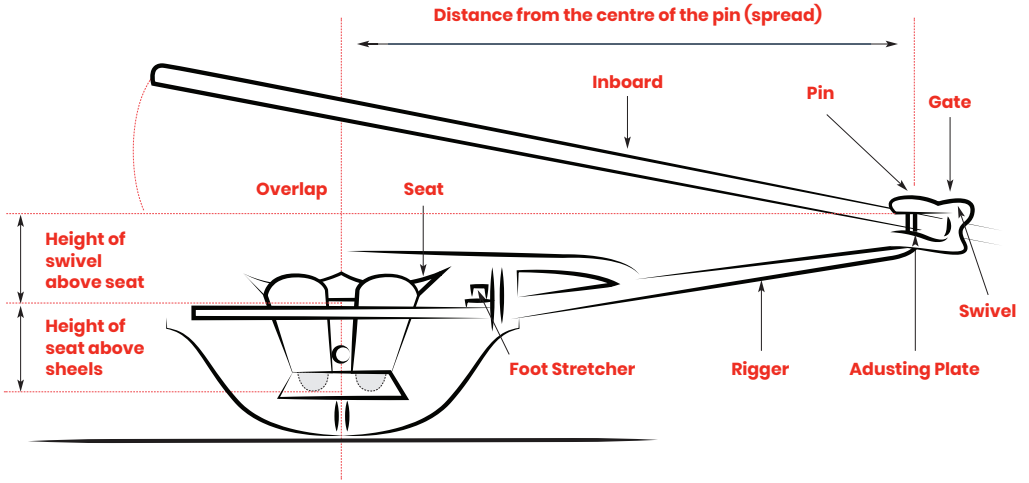
Because the tip if the blade is not locked to the water: it slips forward with the boat at catch, then backwards, then forward again, so the boat travel per drive could be 4m and more. An average 8+ travels about 4.5m during the drive at 36 spm. The boat continues to travel during the recovery phase, how far depends on the amount of acceleration the athlete can generate during power phase.

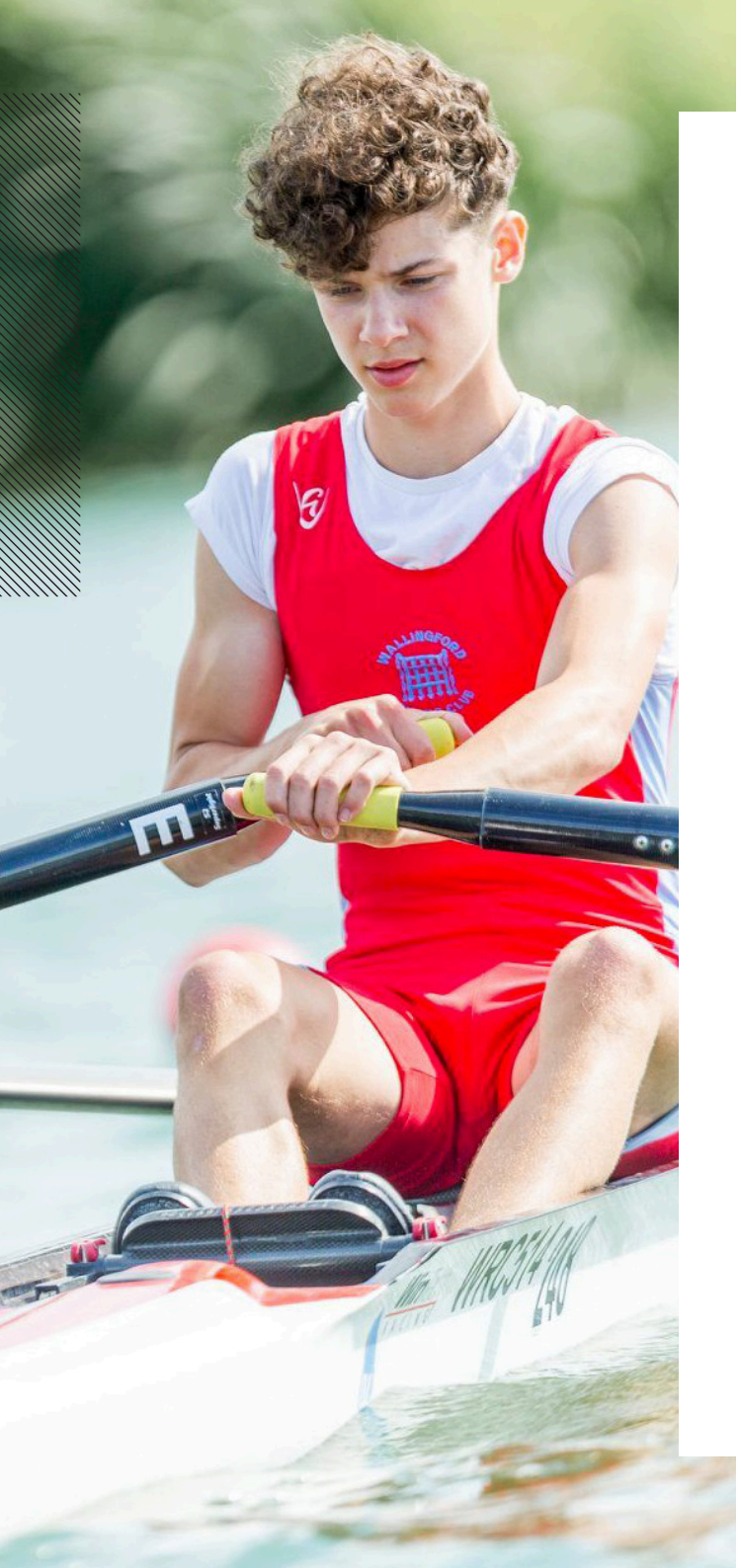
So if the outboard is too long you may achieve a long stroke but the load will be too heavy for the athletes to generate any acceleration. A good crew who can accelerate the boat will travel 1.5 times as far during the recovery as they do during the power phase.

This ratio mainly depends on the stroke rate and is highly correlated with its rhythm – ratio of the drive time to the cycle type: At low rates, during the recovery the boat travels double the distance. At high rates it travels approximately the same distance during the recovery and drive phase.

Fig 4







Sculling - techniques

Most of the information so far has been about rowing although some principles apply equally well to sculling. Young people's first introduction to rowing is through sculling. Many clubs do not have special equipment for small people but if the equipment is so out of proportion that it makes sculling more difficult, then the pupil is likely to lose interest and try another sport.

Dealing with the crossover of the hands is perhaps the most difficult part of the sculling skill to be learned. The size of the overlap will have a bearing on the ability of the young sculler to cope with the cross over. Conventional wisdom determines this to be between 18-22cm. (See Fig 5), but this is far too much for smaller sized people.

The crossover is achieved on the recovery by the left hand leading out and just above the right, placing the knuckles of the right hand into the wrist of the left. On the drive phase, it is achieved by the right-hand leading and just below the left, again with the knuckle in the wrist to eliminate vertical separation. To assist in this action, the left-hand gate should be set at least 1cm above the right.

SO WHY DO WE NEED THE CROSS OVER?

By increasing the inboard length of the oar, we increase the mechanical advantage for the sculler as well as increasing the stroke length.

HOW MUCH CROSS OVER SHOULD THERE BE?

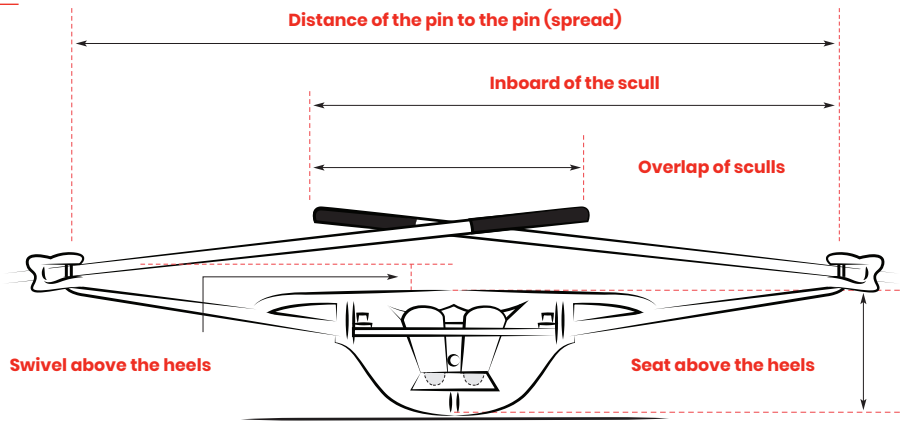
As much as possible providing you are able to uncross your hands and separate them by at least 10cm at the finish of the stroke, allowing the thumbs to brush against the rib cage around the third rib (up from the bottom).

SO WHY NOT BRING THE STRETCHER CLOSER SO THAT THE HANDS CAN BE UNCROSSED?

Because the closer you bring your stretcher, the shorter your stroke length forward. The ratio of the stroke length before and after the pin should be 60-40. Also, once the body position has been set relative to the pin it should not be changed for the rig. Change the rig to the body position.

Small people need shorter oars and less inboard. A rule of thumb is that the hands should not actually cross but sit one above the other when the oars are at right angles to the boat. This is because the leg length is not long enough to allow the hands to uncross.

Fig 5

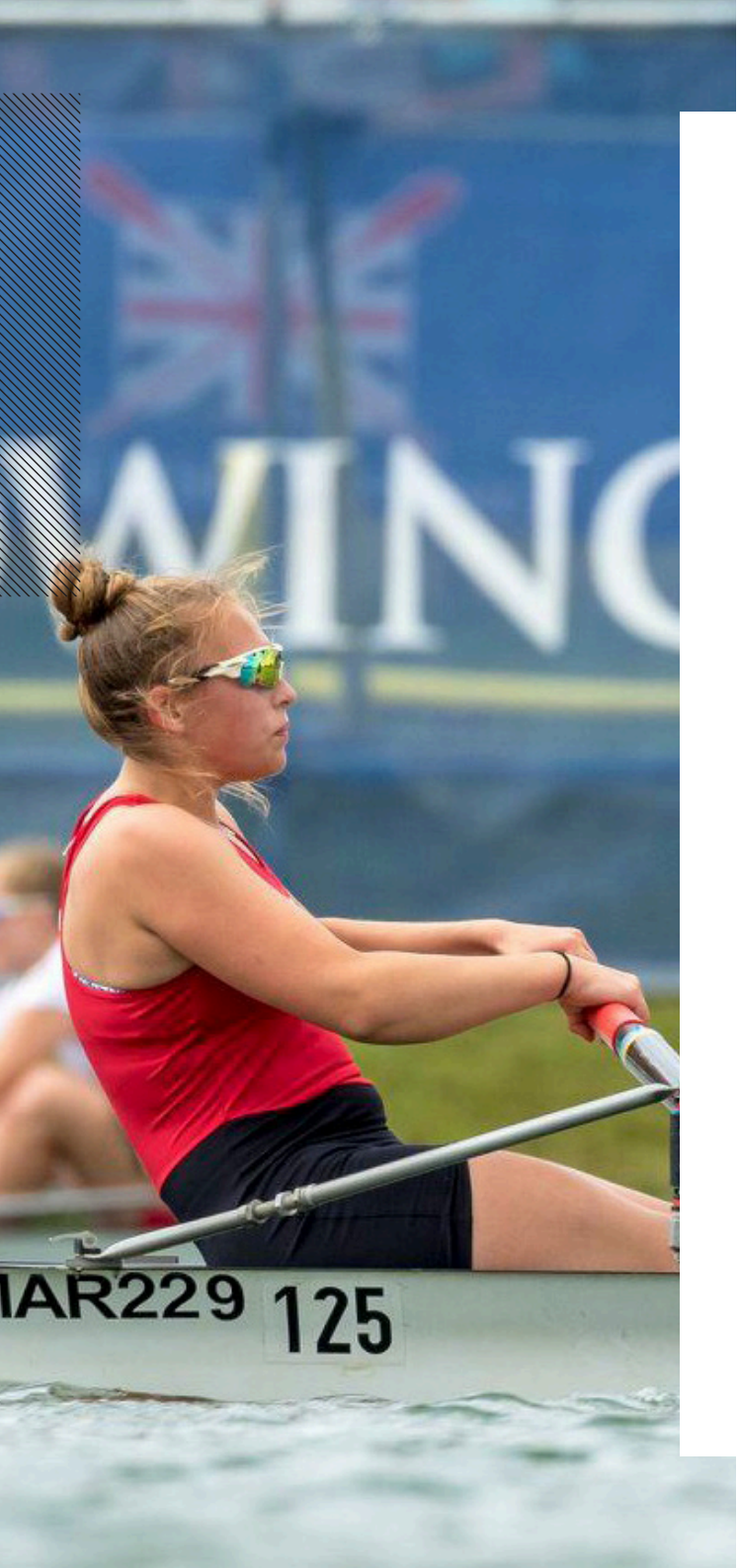


Gearing - the gear

Over gearing can be disastrous and the symptoms will be, inability to increase the stroke rate, lack of contrast between the power phase and recovery rushing into the front stop. Over gear can also be caused by too big a spoon size, too narrow span or not enough inboard.

If you are not sure, err on the light side because light gearing can be supplemented by an increase in the stroke rate. Take a crew that can move the handle 165cm, and a second who can move the hands 150cm. With the gearing set up the same, for both crews to complete 2,000m in 6 minutes, the first crew could rate 36.5 whereas the second crew would have to rate 40.

> Increasing the stroke rate will increase the boat speed but only up to a point. The upper limit of rate is when the time taken during the power phase is equal to the time taken during the recovery.



Rigging chart - rig to height

It is reasonable to say that shorter people should row with shorter oars and narrower spans than taller people. Although this would mean that they row a shorter stroke, they could row at a higher rate whilst maintaining the same work to recovery ratio.

There is a relationship between the height of the rower and the rig. The following chart give a suggested range of rig related to the height of the rower. The range should be achievable by using adjustable length oars and also within range of adjustable riggers. However, there are other factors that need to be taken into considerations such as strength and flexibility.

	8+		4's		2's		1x		2x		4x	
Height of Rower	Span Oar	O/A	Span Oar	O/A	Span Oar	O/A	Span Oar	O/A	Span Oar	O/A	Span Oar	O/A
185-195	83-84	372.5-375	84-85	372.5-375	84-85	370-372.5	156-158	285-287.5	155-157	286-288.5	154.5-156.5	287-289.5
176-185	82-83	370-372.5	83-84	370-372.5	84-85	370-372.5	156-158	285-287.5	155-157	286-288.5	154.5-156.5	287-289.5
166-175	81-82	367.5-370	82-83	367.5-370	83-84	367.5-370	154-156	282.5-285	153-155	283.5-286	152.5-154.5	284.5-287
155-165	80-81	365-367.5	81-82	365-367.5	82-83	365-367.5	152-154	280-282.5	151-153	281-283.5	150.5-152.5	282-284.5

Testing rig - speed coach

There is no short cut from trial and error to finding the best rig for a crew. Today there are several systems on the market that measure boat speed, the most popular of which is the Nielsen-Kellerman SpeedCoach. With the speed measuring device in the boat it does reduce the subjective element and is the easiest and most reliable way to measure improvement.

By keeping the speedometer in the boat, you will see a trend either positive or negative in the changes to rigging. There are too many outsides influences that affect boat speed to rely on one measurement.

If you cannot afford a measuring system then it can be done manually. It will mean you timing all your crew's pieces over a measured distance.

A suggestion is to divide your stretch of water into 250m blocks and with a stopwatch time them as they pass each mark. However, this is far more time consuming than measuring with a SpeedCoach.

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