KIT SETUP AND TUNING FUNDAMENTALS:

PART 3: FINS

WORDS: SIMON WINKLEY
TECHNICAL CONTRIBUTION: DIETRICH HANKE WWW.MAUIULTRAFINS.COM
PHOTOS: ALEX IRWIN (SPORTOGRAPHY.TV) AND SIMON WINKLEY
ILLUSTRATION: PETE GALVIN

ONCE UPON A TIME I WAS IN ANTIGUA ENJOYING PERFECT CARIBBEAN TRADE WINDS OFF THE NORTH SHORE BETWEEN PRICKLY PEAR ISLAND AND SHOAL POINT WHEN I LANDED A JUMP OFF A CHEEKY SLICE OF ROLLING SWELL AND MY FIN SNAPPED OFF. The 3km I had to sail back downwind to base with my harness secured to the underside of the board for lateral-resistance-at-a-price was about 900 times less fun than the session I was previously having and gave my body the equivalent workout of a month at the gym. It reminded me of the importance of fins and, from that point, I started paying more attention to them (as well as checking their condition before setting out…!)

Freeride fins for blasting around are one of the most common types

This article about fins is the third in the series of basic kit setup and tuning and covers a range of windsurfing styles to give the best overall picture.

The function of fins

If you need any convincing that fins play an important role then, in a safe place to do so, try windsurfing for a few minutes with no fin. It's quite a fun challenge at first yet heaving your back foot under your body every few seconds soon becomes tedious as the shape of the board alone cannot prevent its tail squirrelling downwind. Fins are an essential part of the lateral resistance that we need to balance the lift from the sail and to convert it into forward motion. Fins also provide the directional stability we need to keep the board on the right track.

How do fins work?

Fins create lift in the same manner as a plane wing or a windsurf sail. A sail pulled in to the correct angle to the wind (having the right angle of attack) directs the airflow around the windward and leeward side to form low and high pressure which, in turn, creates lift. This was described in issue two which is now a free resource on the WSUK website in the Coaching Special.

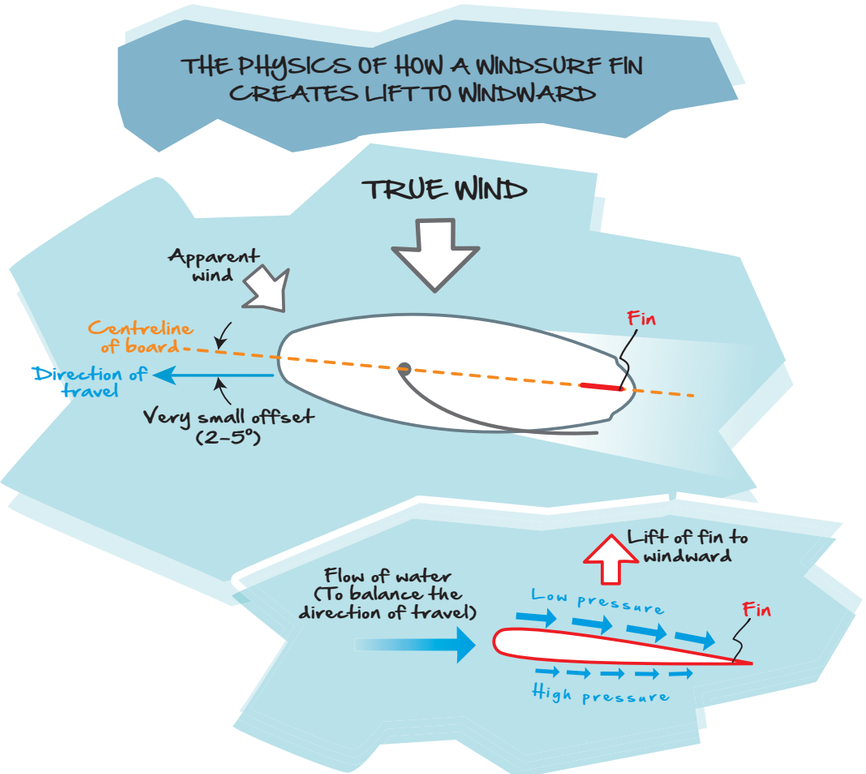
But the question is how can an angle of attack be achieved with a fin that cannot pivot, as it is literally bolted onto the centreline of the board? Water, in our minds, is flowing equally over a symmetrical fin and equal flow cannot create lift. Towing a rig-less board in a straight line behind a powerboat, for example, would not create any lift on the fin regardless of how fast it went. Furthermore, we know that lift from fins is created in such a way as to pull it towards the windward side of the board. We know this as, when planing, we place our feet in the footstraps on the windward side of the board to force the fin back down which squeezes the board forwards. If we kept our feet on the centreline of the board as we started planing then the lift from the fin would tip us off the board to leeward.

So how does the fin create lift and why is the lift to windward? Dave Gollick (keen UK windsurfer and founder of windsurfingfins.co.uk), Dietrich 'Rick' Hanke (founder, fin designer and CEO of Maui Ultra Fins and German Aerospace Engineer), sail coaching buddy Matt Wright and windsurfing luminary Sam Ross all found time to chat to me about it and I am very grateful to them for their input.

When you are planing along you might be forgiven for thinking that your board is pointing in the direction of the course you are sailing, i.e. thinking that, if your board is sailing across the wind, the centreline of your board (the axis running nose to tail through the mastfoot) is also pointing across the wind. Well, perhaps surprisingly, that is not the case. The centreline of the board is not identical to the sailed course so there is a very small offset angle between the fin and the direction sailed - typically 2-5 degrees (or higher when planing upwind when the board is slow and the side force from the sail is high). This offset represents the 'side-slip' or 'angle of attack' or 'leeway' that we need to create lift. It is naturally created by body weight pushing through the feet on the board's tail as a result of hanging out from the rig to balance the lift from the sail.

The reason that the fin creates lift towards the windward side of the board is that, being offset from the direction of travel, the fin has its windward side tilted very slightly away from the incoming water flow and therefore the water flow has further to travel over the windward side. This creates high pressure on the leeward side, low pressure on the windward side and – hence – lift to windward.

If we push too hard against the tail of the board then the angle between fin and direction of travel becomes too great (at about 8-12 degrees) and flow separation occurs (the fin breaks free from the flow of water and spinout occurs where the board skids downwind). Skill, instinct and experience allow the windsurfer to make small dynamic adjustments to prevent or correct spinout in much the same way as a bird limits stalling by natural talent.



The natural offset of the centreline (and fin) to the oncoming water creates lift on the fin in the same way as oncoming air creates lift on the wing of an aeroplane

A range of fin types and shapes: (from left to right): slalom/race, freeride, freewave single, freewave thruster setup (tri fins) and freestyle

Ultimately the exact angle of attack for planing or spinout will depend on a combination of speed, course sailed, wind speed, sailor skill and weight, water state and the size, type and condition of the fin.

To balance our ride, the side force of the sail must be matched by the side force of the fin and board. This is Newton's Third Law: 'for every action there is an equal and opposite reaction'. So why don't we need a fin with a surface area of 7.0m to balance against a 7.0m sail? Well, water is significantly denser than air and has a greater viscosity (liquid thickness/resistance to flow) so a fin can be much smaller than the sail to produce the same amount of balancing force. The forward motion of the windsurfer also creates a proportionate amount of drag (which limits speed and performance) which we have to accept. A thinner fin with a higher specification and in good condition will create less drag and go faster than a lower quality, thicker fin in poor condition.

Fin characteristics, setup and types

Fin profiles, like boards, come in many shapes and sizes. The profile determines how it behaves and this in turn contributes greatly towards the feel and function of the board.

Fin characteristics (that have to keenly balanced by fin designers) are:

- **Length:** a longer, straighter fin is better for lighter wind straight line blasting and a shorter, more swept-back fin is more suited to a higher wind manoeuvre-oriented style such as that of wave/freewave sailing.
- **Aspect ratio:** high = longer and thinner for lift and speed, low = shorter and thicker for manoeuvrability.
- **Surface area:** greater = more lift, lesser = less lift.
- **Thickness:** a balance between thinner for less drag and thicker for less flex.
- **Rake:** how steep the fin is angled back. More rake = less drive.
- **Stiffness:** this is determined by the elastic behaviour of the material. Loading up a fin causes it to flex as all material is subject to bending. Too much flex can reduce performance yet help to provide a more forgiving ride and produce springback in wave fins for increased grip and projection off the lip.

Setup variations are:

1) **Single –** one centre fin.
2) **Thruster (or tri-fin) –** three fins: one centre fin plus a pair of smaller fins either side further forward. These cannot be driven against by the back foot as much as single fins yet offer a good balance between maneuverability and drive. Switching from a single fin to tri-fins on a freewave board will result in a significant shift in how smoothly and easily the board carves, especially if, at the same time, the footstraps are moved from the outboard position with double back strap to the inboard position with a single back strap.
3) **Quad –** four fins: one pair of small rear fins near the middle plus another pair of even smaller fins on the outside a little further forward. These allow the hardest carving, precise grip on the bottom turn, radical sliding-out/pulling back of the board on the top turn, the softest landings and, being shallow, the smallest chance of catching the fin on anything solid under the water. At the most radical end of wavesailing they are often preferred as, during the hardest bottom turn carving, there will always be two fins biting into the turn when it matters most.
4) **Twin –** two fins: one pair of small rear fins.

Two options for a 103 freewave board: either a single 28cm centre fin or a thruster setup with a 20cm centre fin and two 11cm side fins

Different fin heads: (from top to bottom) deep tuttle box, tuttle box, power box, US box, slot box (single bolt)

Fin types include:

1) **Freeride/freemove/freerace:** single centre fin – designed to give the best of everything. Relatively long, upright in the mid section to push through the feet for lift/blasting. Has a gently swept tip to keep the tail under control in carving turns.
2) **Wave:** small, very swept back fins to enable the best range of movement on a wave face. Can be set up as either a thruster, quad, single, or twin (with single and twin not so common these days). Modern wave boards often have five fin boxes (one US box plus four Slotbox or five Slotbox) to give the option of thruster or quad setup (or possibly twin or single setup if required).
3) **Freewave:** between freeride and wave, mostly with the option of either a single freeride centre fin or a thruster setup.
4) **Slalom/race:** single, long, straight centre fin = early planing and raw power for specialist high-wind racing. These are typically the longest of all fins with the straightest profile to provide the drive needed against the biggest sails that can be held onto. Thin, low-drag profiles give quick acceleration with control at extreme top speed.
5) **Freestyle:** single, very short (typically 15-24cm), stubby centre fin with a thin profile for fast, upright-stance early planing, high maneuverability and ease of sliding. To the uninitiated, freestyle boards are very hard to sail in a straight line as the fin offers such little support for a normal, outboard stance making it prone to spinout.
6) **Speed:** single, relatively long/straight centre fin with specific rake angle and low drag characteristics for high speed, straight line speed challenges.
7) **Weed:** heavily-raked versions of regular fins to allow weed to slide off to avoid the board slowing or tripping at speed over unwelcome patches of seaweed.
8) **Delta:** single, fast, very low-profile (squashed triangle) for slalom and speed in shallow spots and also suitable for thick seaweed.

Boxes

A fin box is the slot in the board that the fin is bolted into. Fin heads, of course, must match the box to enable them to be used. The current main types of box are:

- **Power box:** typically on freeride boards using a single M6 bolt through the top of the board. The fin needs to fit snugly having only one fixing.
- **US box:** typically the centre fin position on wave/freewave boards for a thruster setup or for a single fin. Held by a captive pin through the rear of the fin head and a M4 bolt under the board with a square brass nut at the front. US box fins can be sacrificial. The front piece of the head is designed to snap on impact in shallow water to save the box being ripped out of the board.
- **Slot box:** typically the two or four outer fin positions (or all three, four or five positions) on wave boards for thruster or quad setups. Uses either two M5 bolts through the underside of the board or one bolt if the front of the fin head hooks under a fitting in the front of the box.
- **Tuttle box or Deep Tuttle box:** typically slalom, freerace or bigger freeride boards using two M6 bolts through the top of the board. Sometimes called Foil box when heavily reinforced for foil specific or foil-ready boards.

On multi-fin boards, slot box covers/blanking plates can be used to cover any unused slots if required to reduce drag. If fins can be moved forward or back in the box (i.e. with US and Slot boxes but not with Tuttle or Power boxes) then moving forwards gives a looser feel for better carving and moving backwards gives more stability for blasting.

Fin selection

Selecting the right fin is as important as your choice of board and sail yet is often overlooked. When you buy a new or used board and get just one fin option with it (one single fin or one set of multi-fins) then that's what you're going to use. On some days this will work whilst on others you might have control issues. You need more than one option to match different conditions and sail sizes. Operating a one-option policy for fins is perhaps like owning a pair of flip flops and using them for everything. On some days you will get by just fine yet on others, like when you're being chased by a hungry polar bear down a snowy slope, you might wish you had something more suitable.

Having a range of fins is the key to balancing the power in the sail to maintain control

Fins come in four materials (from top to bottom)

- pre-preg carbon/ fibreglass composite
- carbon
- G10
- plastic composite

Fin calculator

My CarveIQ 114 freemove board comes with a single freeride 38cm fin yet the fin that comes with a board will only go so far in balancing the power from a range of sail sizes. I run four fins on this board: K4 Fang freeride 34, 36, 38 and 40cm. This board has a massive range of use but only if you match the fins to the sails you use.

As a rule of thumb for single fins, take your sail size and multiply it by five then add 4cm (for boards above 110 litres) or add two (for boards below 110 litres). Then tune up or down as follows:

- Increase fin length by 1-4cm for lower ability or heavier sailors or when marginally powered or underpowered or to help with planing upwind.
- Reduce fin length by 1-4cm for higher ability or lighter sailors or when solidly powered or overpowered
- Increase fin length by up to 10cm for pottering about in non-planing conditions to help to stay upwind.

So, as a 76kg sailor, the sails I use on the 114 and their corresponding fin sizes are:

- 5.3 Blade = 5.3 x 5 = 26.5 + 4 = 30.5 (I use 34cm*)
- 6.0 Gator = 6.0 x 5 = 30 + 4 = 34 (I use 34cm or 36cm)
- 7.0 Turbo or NCX = 7.0 x 5 = 35 + 4 = 39 (I use 38cm)
- 8.1 Turbo = 8.1 x 5 = 40.5 + 4 = 44.5 (I use 40cm)

*This works perfectly for well-powered coaching yet, when sailing for myself, I would usually be sailing my Kode Freewave 103 when it's windy enough for a 5.3. I cannot really get away with shorter than a 34cm fin on the CarveIQ as it is 76cm wide so I am happy to sail with the extra lift from the fin. When I use the 5.3 on the 103 and use a single fin then I would use a 28 or 30. For better carving (and higher winds) on the 103 then I would swap to a thruster setup with a 22 and two 12s or a 20 and two 11's. Don't worry that a 20 plus two 11's equals a total length of 42cm. The area of the fin is more important than length. One fin is more effective than three fins. One fin has less drag. The advantage of a thruster setup is maneuverability and not performance,

Further up the scale of board sizes the CarveIQ 141 comes with a 46cm fin and can take a 9.5 sail. Now imagine that, on a day when some people are out at your local spot planing on 100-110 litre boards on 5.0m sails, you also want to go out and play yet you have not progressed beyond a 141 litre board yet. So you take the 141 out with a 5.0m sail (below the minimum recommended sail size of 6.5 but it's what you need to support your progression at this time) and the stock 46cm fin. Do the calculation: 5.0 x 5 = 25 + 4 = 29cm required. Yes, that is too small for a 141 but the 46cm fin is going to make your board feel like a ride on a wild horse. So a step down fin is needed to enable you to stay in control. So a 36-40cm fin, whilst not fitting perfectly into the standard equation should help to bring your board back under control.

Plastic progression: (from left to right) Hifly older-style intermediate, Drake Shallow beginner (two lengths), K4 freeride/freewave single/freestyle

Fin materials

There are a number of different materials that fins are made of. Considerations when choosing the fin material include price, durability, stiffness/flex and weight.

G10 fins

G10 is fine-weave fibreglass matting with epoxy resin, laid up and pressed under weight to produce a dense, durable laminate. CNC (computer numerically control) machines shape the blanks into one-piece fins. G10 has high impact resistance, is one of the most common materials used in fins yet is relatively heavy.

The varied styles of plastic composite fin technology: K4 Fang, 3SW, Bubble and Shark II fronts

Look after your fins. These two freeride 38s have (had!) exactly the same profile until one got a little unloved…

Fin bag

Fin covers

Plastic composite fins

Plastic fins, for example on beginner boards, can be basic. UK-based K4, however, are the world leader in plastic composite fin technology with a whole range of robust, high performance fins, iconic in bright yellow and now also found in orange on new RRD wave/freewave boards. K4's original Dynamic Flex material makes it ideal for wavesailing performance. The alternative Super Stiff material compares with the stiffness of G10 and makes it suitable for stiffer wave fins as well as freestyle, freewave and freeride.

Carbon fins

Pimping your board with a carbon fin means getting the best and lightest fins around yet being typically custom made, hand-layed and wet-sanded by hand, the bill for a set of top-end carbon slalom fins would be enough to make most people pass out. Pre-preg carbon and fibreglass composite fins blend materials to balance the performance and cost of G10 and carbon.

Fin success

Here are my top 10 tips to avoid fin-related failure:

1) Always take your fins with you when you go windsurfing. Rigging up in perfect conditions only to discover that you have left them at home is a serious drama.
2) Put fins in the right way round with any sweep to the back!
3) Love your fins and keep them in great condition, smoothing them off from time to time (especially on the leading edge) gently with fine sandpaper (180 grade) then wet and dry (300, 400 and 600 grade) to reduce drag and spinout.
4) Invest in a fin bag or padded box to keep them together. Return them to their fin covers when rinsed and dried.
5) Select the most appropriate fin size you can for each session.
6) When coming into the beach always stop the board and get off before the fin stops you in the style of a plough.
7) Carry spare fin bolts and nuts and use the right screwdriver to tighten them securely (usually Phillips size 3 or large flathead for Power box, Tuttlebox and Slot box and medium flathead for US box).
8) Check your fins before every session to avoid wobble, dropout or failure at sea.
9) Always remove the fin cover before sailing. When you set off and feel the fin flutter you will know what you need to do!
10) Wear shoes when windsurfing or focus really strongly on correct foot positioning, especially when waterstarting, to avoid a finjury (foot slicing).

That completes the third part of kit setup. Now it's up to you to try different fin setups until you find something that feels right for you…maybe even heading to your local windsurf shop to buy some new fins. If you missed either of the first two articles in the series then head to the WSUK website to order or download previous issues and to subscribe for future FUNDAMENTALS articles.

Thanks to:
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Steve Thorp www.k4fins.com,
Matt Wright and Sam Ross

Rosie and Charlie are the most lovely windsurfing couple you could hope to meet yet they do love a good finjury. Be careful out there…

Simon Winkley is a RYA Advanced Windsurfing Instructor and a RYA Windsurfing Trainer.

Sponsors: Starboard, Severne, K4 Fins, Flymount, Bray Lake Watersports & Spinlock.

Overseas Coaching Clinics via Sportif:
Alacati, Turkey
29 June 2019 (last few places)
Langebaan, South Africa
25 November 2019
Costa Teguise, Lazarote
(reserve a place now for March 2020)
Bookings www.sportif.travel Tel +44 (0)1273 844919

Weymouth Coaching Weekends at the OTC:
(bookings: info@simonwinkley.com)
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Connect: www.simonwinkley.com
info@simonwinkley.com - Facebook @swwinds - Instagram @simonwinkley