WINDSURFING MASTS

Everything you need to know

WORDS: SIMON WINKLEY
PHOTOS: MATHIAS MOERMAN, *TWO GOAT MEDIA*; ALESSANDRO ZATTI; SIMON WINKLEY; FELIX BERNASCONI
ILLUSTRATIONS: PETE GALVIN
TECHNICAL CONTRIBUTIONS: ALBERTO SOLZA, *EXECUTIVE VICE PRESIDENT SALES, ITALICA S.p.A*; DIETER VAN DER EYKEN, *SEVERNE CUSTOMER SERVICE MANAGER & TEAM COORDINATOR*; BILLY SHORT, *UK WINDSURFER*

THE FIRST MAST I OWNED WAS A WELL-USED 15% CARBON 430. BEING ON A BUDGET, I THOUGHT THAT SOUNDED LIKE 14% MORE CARBON THAN I REALLY NEEDED YET IT WAS CHEAP, THE RIGHT LENGTH, HAD A NICE STICKER ON IT AND GOT ME OUT ON THE WATER ON MY 5.7 FREERIDE SAIL. I never really gave the mast much thought until one day I tried a new 75% carbon one which was actually compatible with my sail and cost about 8 times as much. It took a full 2 minutes of sailing it to realise why I had spent so much of my time battling with my rig on windy days. I robbed a bank, bought the lightweight mast and never looked back. Sailing with a decent mast was a revelation: the rig was now much lighter in the hands, more responsive at speed, better balanced, more manageable in transitions and tended not to force me under the water quite so much when I was learning to waterstart. Since then I always purchased the best, lightest masts I could afford and continue to appreciate how fundamental a mast is to the way a sail performs.

Testing the next generation of masts with a perfect backloop landing
Pic: Two Goat Media
Rider: Dieter Van der Eyken

Coming in to land:
one moment before the previous photo
Pic: Two Goat Media
Rider: Dieter Van der Eyken

Questions

Understandably people make lots of enquiries about kit when they are looking to make a purchase and masts, carrying a certain air of mystery perhaps, generate plenty of discussion.

- “What’s the big deal with masts? Surely the sail is more important…”
- “Are expensive masts really worth it?”
- “There’s a lovely 1983 pink one-piece mast on ebay for £250…should I go for it?”
- “How much carbon content do I need…?”
- “Hard top, flex top or constant curve?”
- “Can I get away with one mast for all my sails?”
- “SDM or RDM…anyone heard of MDM masts?”
- “My mast sections are stuck together – what can I do?”
- “If I buy the 3 masts I really want, is it guaranteed to end in divorce?”

A very brief history of masts

Hard-anodised aluminium masts came first in the 1970s thanks to dinghy sailing which had seen a shift from wooden masts to aluminium ones in the 1960s. Some were in 2 or more sections yet most preferred 1-piece as any joints were weak points. They were notorious for corrosion, staying permanently bent, splitting and snapping. Fibreglass (epoxy) masts expanded the choice in the 1980s and, despite the bright colours, were heavy and had poor bend characteristics. In 1-piece, however, they were more durable then aluminium. Early 2-piece epoxy masts were unpopular with some as they were even heavier than 1-piece masts of the same length and they also had a hard spot in the curve (the aluminium ferrule which joined the sections) which could reduce performance and cause the mast to fail. Some designs combined multiple sections of both aluminium and epoxy. All 1-piece masts needed car-topping and were perfect for budget pole-vaulting, jousting, slapstick comedy routines at the beach and fishing.

Carrying 1-piece masts inconspicuously was easy as the boards of the day were around the same length

Carbon was gradually introduced in the late 1980s as ‘reinforcement strips’ on epoxy masts. Then this remarkable material went solo in the 1990s before gaining real traction in the new millennium. I salute all those who enjoyed windsurfing despite the challenges and drawbacks of the old tech masts. They all took the game forward. Today’s carbon technology has enabled the strongest and lightest masts to be produced which means that windsurfing now enjoys a level of reliability and performance previously unimaginable.

The importance of masts

Choosing the right sail is important. Using a good boom feels great. Then there’s the mast – the backbone of the rig - and it plays a vital role in power control. The dynamic stresses of planing, wave riding, freestyle, racing, pumping, jumping and crashing all need to be dealt with by the mast. Even at rest on the beach it remains forced into a hard curve, defining the entire rig.

The mast is working hard here to stabilise the power in this gybe preparation phase in well-powered conditions

Mast lengths

Masts are measured in centimetres and come in a variety of lengths, typically from 310 to 550 in 30cm intervals (with some variants). One mast can be used to cover multiple sail sizes by making use of an extension (to make it longer) or an adjustable head (to, effectively, make it shorter). Basically, stick to the sail maker's recommendations and invest in a new longer or shorter mast if your current mast does not fit into the guidance. Length and other info can be found printed on the mast.

Adjustable head sails (usually only found on older or very small sails) can lure the unsuspecting sailor into extending the webbing to the max and shoving up to a metre of unwanted mast length beyond the head of the sail into the plastic cap. This sets the sail with a stiffer mast than it should have which makes it very hard to downhaul and compromises the control of the rig. This is commonly seen in storm sessions where sailors using their smallest sails do not have a short enough mast so they do the best they can.

When it is really windy it can feel like your 3.3s or 3.7s are too twitchy and hard to use in the huge gusts and lulls. The correct mast would help as it will be soft enough to allow the head to open in gusts with the sail rigged normally (so not too flat) to keep fullness low down during the lulls.

Some brands, for convenience and cost-saving, sell interchangeable mast section lengths to enable a range of masts lengths to be constructed from mix-and-match sections. Those that offer this have web-based guidance on how to get the most from their systems.

Above: Info such as length, weight and IMCS can be found printed on the mast

A mast extension allows one mast to be used with a limited range of sail sizes

SIMPLE GUIDE TO WINDSURFING MASTS
Typical lengths, sail ranges and IMCS

simon winkley WATERSPORTS COACH

Length	Relative length	Type of sails used with	Approximate sail range	IMCS (can vary)
310	Ultra short	Tiny sails	2.7 – 3.0	12
340	Very short	Very small sails	3.0 – 3.7	15
370	Short	Small sails	3.7 – 4.5	17
400	Medium/short	Medium/small sails	4.5 – 5.5	19
430	Medium	Medium sails	5.5 – 6.5	21
460	Medium/long	Medium/large sails	6.5 – 8.5	25
490	Long	Large sails & high-aspect foil sails	8.5 – 9.5 & 8.0	29
520	Very long	Large high-aspect foil sails	9.0	32
550	Ultra long	Very large high-aspect foil sails	10.0	36

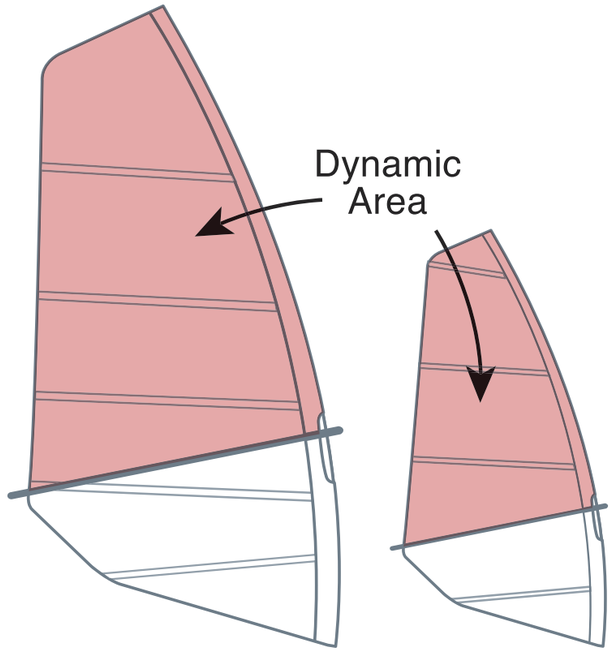
IMCS

Masts have an IMCS rating. IMCS stands for Index Mast Check System and the number refers to the stiffness relative to the length and so describes its responsiveness. With the mast supported at each end and a 30kg weight hung from the mid-point, measurements of deflection are taken at the ¼, ½, and ¾ points from the bottom and are put into a formula including the length of the mast to give an IMCS number. The IMCS number ranges from 12 (for a 310) to 36 (for a 550). The IMCS number is pretty much fixed for each mast length (with only a few small differences seen from some brands) so there's no need to worry about it really. A few years ago someone posted on a forum a great way of getting your head around mast stiffness: "Before IMCS, masts were listed by stiffness. But if you made the same mast longer it would rate as floppier when in fact it was not…it would be the same but there would just be more of it."

The dynamic area of a sail is found above the boom and, the larger the dynamic area, the more support is needed for a stiffer mast. Visualise having a long mast in a large sail that was really bendy. The sail would feel springy and unstable and bottom end power would be lost. The centre of effort in the sail would be squirrelling all over the place and so would the sailor in their attempts to control it. Now imagine a short mast in a small sail that was so stiff that it hardly bent at all? The sail would feel flat, dead and heavy and it would struggle to twist off, thus being unable to respond to the power changes.

Mast Stiffness

The larger the dynamic area, the more support is needed from a stiffer mast

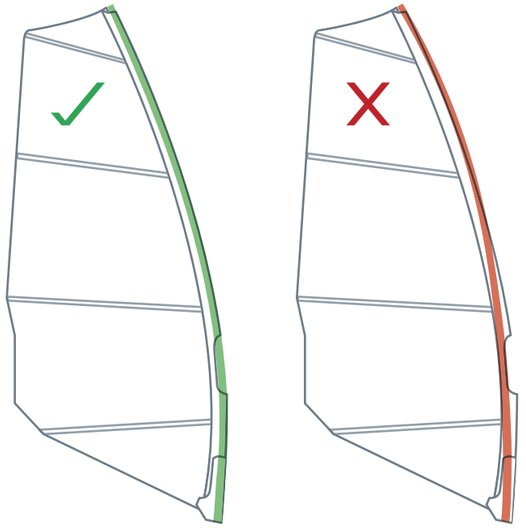


Curve characteristics

Sails are designed around their own brand of mast and masts need to fit perfectly into the curve of the luff when the downhaul is applied. Designers will do what they need to do to deliver the best product/experience to their customer, yet they will not be thinking at all about how another brand's equipment might work with theirs. Differences in mast curves and luff curves, therefore, exist between brands (and within brands from different eras). The wrong bend curve can alter the height of the centre of effort in the sail which can cause control problems.

Mast Compatibility

The mast should fit the profile of the luff curve

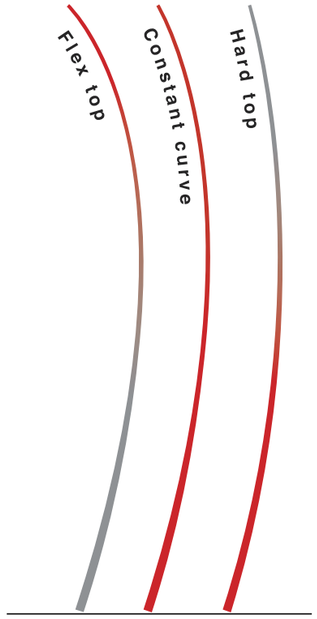


Mast curve fits snugly into luff curve =
Best performance

Mast curve at odds with luff curve =
Loss of performance

Mast Curve

There are 3 typical mast curve profiles to suit different sail designs



Masts typically have 3 different bend profiles (constant curve, flex top and hard top). Constant curve masts have a fairly uniform bend along their length. Flex top masts have a bit more bend in the tip and hard top masts are a bit straighter in the tip. Today most masts are constant curve so it is perhaps getting easier to get it right. Take care, however, if using equipment pre-2013 as the 3 categories were much more evident back then.

Some take a combined approach to these categories. NeilPryde and Goya, for example, currently have a 'progressive flex' system where the bend characteristics change across their mast lengths. For example, Pryde's 340 and 370 masts are flex top, their 400, 430, 460 and 490 masts are 'constant curve flex top' and their 520 and 550 masts are constant curve.

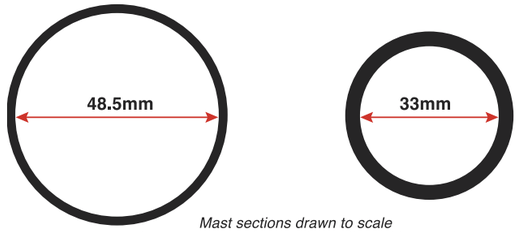
The best advice is to buy your mast and sail from the same brand and broadly of the same era if you can. Speak to your local shop to check compatibility and they will be happy to help. Generic mast brands (i.e. those who do not make sails, like TSL and MaverX) stay up to date with the latest mast curves (they both use constant curve now actually) so should be a safe bet in most cases. If you are buying masts for sails you already own or sails for masts you already own then a good resource to help you to achieve compatibility can be found on the Unifiber website where they have a 'Masts Selector' reference chart. As you will see (on both their original and updated reference charts) the vast majority of masts sit in the constant curve range with only a few notable exceptions: https://www.unifiber.net/masts-selector

Carbon content

Stated carbon content is typically between 30% and 100% Masts with more carbon are lighter and more expensive. A 100% carbon mast would contain carbon fibre plus epoxy and would be less durable against impacts. A 75% carbon mast would contain 75% carbon fibre and 25% glass fibre plus epoxy and would offer good balance of lightness and durability (i.e. perfect for wave sailing).

When Severne introduced their 2017 range, carbon content was no longer stated as their masts were now being described in terms of weight and function. Whilst Severne's own carbon percentages are measurable, comparison to other mast brands' stated percentages can be misleading. Here follows an example of the problem. A top of the range Severne Red RDM 400 mast weighs 1.3kg. There is a 100% carbon RDM from another brand out there that weighs 1.65kg which is 25% heavier! Possible reasons for this are: 1) variances in the quality and/or quantity of the materials used; 2) a difference in wall thickness; 3) a disparity between the actual and the stated carbon content. Dare I suggest that a rounding-up of carbon content for convenience does happen? At the time of writing all brands except Severne continue to use carbon content to define their windsurf mast ranges. Carbon content is perhaps what most windsurfers still use to guide their thoughts. It drives sales and helps shops to upsell, for example, a 90% mast to a customer who walks in asking for a 60% one. Despite its flaws, carbon content referencing is understandably quite a hard habit to break. Please remember though that weight is a critical factor when buying a mast

SDM and RDM Mast Sizes



Mast sections drawn to scale
All dimensions reference the bottom of the mast

SDM
Outside diameter = 53mm
Wall thickness = 2.25mm

RDM
Outside diameter = 40mm
Wall thickness = 3.5mm

Wall thickness and outside diameter can vary according to the specification of the mast

Mast thickness: SDM vs RDM vs MDM

With the introduction of epoxy masts in the 1980s, mast diameters became quite standardised. Reduced diameter masts (RDM) appeared in the early 2000s as wave sails become more compact (requiring a shorter mast) and the optimum diameter for these masts was smaller, offering a good strength-to-weight ratio. 'Normal' masts were then referred to as standard diameter masts (SDM). SDMs are fatter with thinner walls and, whilst they are made in all but the very shortest mast lengths, they are ideal for supporting bigger sails with a larger dynamic area. RDMs are skinnier with thicker walls and have a greater bend capability as well as aerodynamic benefits. RDMs are most commonly used on smaller sails yet it's all down to personal preference: I use 370-460 RDMs in sails from 4.0 to 8.1. Whilst a few RDM 490s can be found if you look hard enough, the biggest RDM mast is typically 460 and some brands only go up to 430. As RDMs of 490 and above would lack stiffness and lose drive, sails from about 8.5 upwards will require a SDM.

Look out for cams designed to work on both types of mast (i.e. Duotone) and interchangeable RDM- and SDM-specific cams (i.e. Severne). Ensure that swappable cams are correctly selected: an SDM cam on a RDM mast is likely to pop off in use and a RDM cam on a SDM mast will not allow battens to rotate properly and will damage the cam and/or the mast. With the correct cam in place the batten rotation should feel smooth and precise.

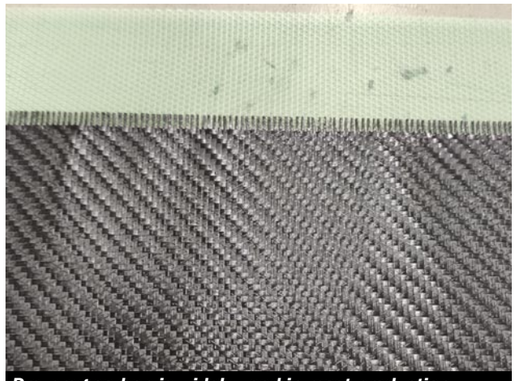
Erm, MDM?

Technology keeps marching on and, at the time of writing, medium diameter (MDM) masts are in their infancy. Such masts (with their distinct geometric pattern) are being built using fully-automated pre-preg filament-winding technology by Australian company Slake to meet the evolving demands of the next generation of windfoil racers. Watch this space…

How much should I spend on a mast?

How much is a piece of string? A well-loved mast should last for years and years. Being robust, and not-fashion-conscious like sails, masts do not need to be replaced so often. Buying a cheaper mast will inevitably make it heavier. Spending too much dollar on masts for very old sails, however, would be overkill. Masts range from about £130 - £900 depending on length and construction. Yet the top end of that price range will be paid by hardly anyone as that would buy the very lightest (100%) 550 mast (which is only really used now on a high-aspect 10.0m foil racing sail). A really decent new RDM or SDM 430 with a weight of around 1.9kg - 2.3kg (or a carbon content of around 70% - 75%) will cost something in the region of £350 - £390. Used masts hold their value well. Expect to pay about 25-50% less than the new price for a very good one with a few year's usage. It's all about the balance and getting the best you can for your budget.

Cams like the Severne RDM/SDM and Duotone Hyper-cam 2.0 provide the correct fit for RDM or SDM masts



Pre-preg carbon is widely used in mast production

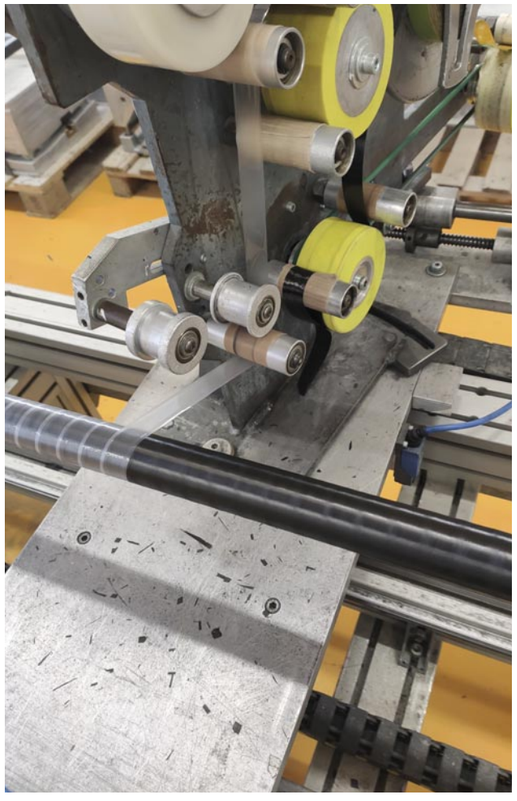
Mast design and materials

Designers must consider and balance the cost, weight, strength, durability and flexibility of materials to create a product that can achieve the best performance for a given price point. The mast material needs to have high tensile strength (so it can withstand being stretched and pulled without breaking) as well as a high modulus (stiffness). Different grades of carbon are used in the construction of masts, the best being Torayca T800 and T900 carbon from Japan. The higher the T number, the greater the tensile strength so less material can be used and the mast becomes lighter. In theory the best material available today for mast production would be T1100. Used to make satellites, however, T1100 is currently too expensive for windsurfing! Masts (some now weighing in at just 1.05kg for a RDM 370) could be even lighter yet they need to be robust. Whilst a 0.5kg mast is possible in theory, it would snap in half every time you put the downhaul on!

Originally, dry filament winding technology was used to make windsurfing masts. This involved winding a dry strand of carbon fibre from a spool onto a mandrel (a mast mould) before adding epoxy resin. Today, pre-preg materials and technology are used where carbon fibre sheet material and tape are impregnated with resin yet remain dry to touch until heated under pressure.

Mast production

There is no such thing as a standard mast which is mass-produced then labelled up with the logos of different brands. Mandrels and masts are painstakingly designed, engineered and refined as the brand R&D teams test the prototypes until final models are agreed, so all products are unique. The factory environment has strictly controlled temperature and humidity and the pre-preg carbon fibre has to be stored at -25°C. Once the mould-release agent has been applied to the mandrel and it has been wrapped and wound with the pre-preg carbon sheet and tape (and pre-preg glass in most cases) it is placed into an autoclave. This machine provides an environment in which the temperature and pressure is increased to 130°C and 3.5 bar. After 1 hour the pre-preg will start to flow and after 2.5 hours the material will have bonded/cooled/solidified and can be taken out of the autoclave and the mandrel removed.



Every mast is deflection tested

Visual inspections as part of quality control

Testing

Masts are tracked through production with their barcode. Several quality control tests are performed:

1) the weight of the mast is measured against a standard reference weight;
2) a 30 kg weight is placed in the middle of the mast with the deflection measured in up to 7 places;
3) the mast is compressed to simulate downhauling yet only to a safety margin of less than 20% of the maximum limit, to avoid damage;
4) visual inspections are performed.

The quality control stamp of an Italica-manufactured mast

Padded bags are essential for preventing damaging knocks to masts

Textured areas help booms to grip with reduced clamp pressure

A boom adaptor provides the best connection between a non-RDM-specific boom and an RDM mast

Some booms have a click-in spacer to switch easily between SDM and RDM masts

Taking good care of masts

Top tips for ensuring that your masts will stay healthy for the long game are:

- Store masts in the shade and, if yours has one, in its padded bag. Knocks and crushing from hard or heavy objects when in storage can cause structural damage. Exposure to UV can cause delamination and degradation of materials.
- De-rig sails after use (especially in a hot climate) and never leave sails rigged overnight. If this is impossible then the downhaul should be released.
- To avoid hidden structural damage, use as little pressure on the boom clamp as possible. No more than two fingers should be needed to close it. Some masts have a textured boom attachment area to reduce slippage, so booms can be clamped with even less pressure. Beware of trapping sand between the mast and the boom clamp as this literally can sand the mast down.
- Ensure that masts are clear of sand, grit and mud when putting the two sections together and when putting the extension in. The highest-spec Severne masts have an oversized EVA plug fitted to the bottom section. This 'cleans' the inside of the top section when joining the mast, by pushing any debris away from the joint.
- Consider winding electrical tape around the joint for two reasons: to keep sand out and to keep the two sections together prior to downhauling. Some masts now fit together so perfectly that slight air compression can push the sections apart a little when they are connected - you don't want this to happen inside the luff tube when rigging.
- Beware of over-downhauling.
- If using cams make sure that they are well-placed, sized to the mast diameter and rotate correctly.
- When launching in shorebreak keep the rig clear of any breaking water and keep the top of the mast high. Be confident that you have enough power and technique to push through any waves. Seeing a grown man cry in a quiet corner of a beach (after launching into waves underpowered with a brand new sail and mast and then - 30 seconds later - falling in, snapping the mast, ripping the sail in half and getting dumped back up the shingle) is a very sorry sight and one that you never forget…

Help…my mast is stuck together!

Prevention is always better than cure so tape it up every time. The often-given advice of clamping a boom onto each section with about 4 tonnes of boom clamp pressure to enable the sections to be twisted apart should never be listened to as it can crush the mast. The best way to help someone wandering along a beach, mast in hand like a dejected Don Quixote, is to get 3, 4, 5 or even 6+ people on each section (depending on just how stuck it is) and, on the count of three, get each team to twist the mast carefully in opposite directions whilst pulling it apart slightly. It's all about strength in numbers and it's a perfect team-building activity for strangers. Attempting to get a little fresh water or WD40 in there beforehand would do no harm. The sand is likely to cause some scratches yet these can be worked out later with a little wet and dry paper. This must only be done in either cooler climates or when the mast has cooled down, as damage can occur if masts are forced apart in extremely hot weather.

So that's it for masts – I hope this article has been informative and that it might help you to consider how well your masts are meeting your needs going forward. Why not ask a mate or a coach to have a ride on your kit to see what they think? A good mast is a very good investment…look after it and it will look after you.

Thanks to: Alberto Solza and Alessandro Zatti of Italica S.p.A, one of the finest manufacturers of carbon products in the world. Italica manufacture around 45,000 windsurf masts per year for brands including Severne, Duotone, GA, NeilPryde, Bic Sport, Pro Limit as well as one-design masts for the Windsurfer and iQFoil classes. I am very grateful to Alberto for (virtually) showing me around his Italy factory this year and for engaging in Q&A sessions. Further thanks to: Dieter Van der Eyken, Mathias Moerman, Pete Galvin, Billy Short & Felix Bernasconi.

Retro photo from: This is Surfboard Sailing by Reinhart Winkler (1979): Nautical Publishing Company Limited.

The Severne oversized-EVA-plug pushes any debris away from the mast joint

The mast is the backbone of the rig
Pic: Two Goat Media
Rider: Dieter Van der Eyken

Simon Winkley is a RYA Advanced Windsurfing Trainer and Instructor.
Supported by Starboard, Severne, K4 Fins, Flymount, Bollé, Bray Lake Watersports, Spinlock and Sails & Canvas.
2021 Overseas Coaching Clinics: Sportif 01273 844919
Costa Teguise, Lanzarote 8-15 May **Alacati, Turkey** 29 June-6 July **Prasonisi, Rhodes** 13-20 September
UK clinics: Weymouth: April-November **1:1 Coaching: Queen Mary SC:** Anytime
Connect: www.simonwinkley.com info@simonwinkley.com - Facebook @swwinds - Instagram @simonwinkley