CARBON SPARS
Seldén was founded in 1960 and has grown to become the world leading spar producer with manufacturing facilities in Europe, USA and Asia. Our products and processes combine reliable and tested methods with the latest technology that enable us to produce spars for Olympic and World Champions, offshore racers, blue water cruisers and family sailors alike. It is this experience and knowledge that we have applied to our latest generation of carbon spars.

Our carbon spars are designed using the latest finite element analysis backed by many years of solid engineering experience.

Our unique production method gives a unique look. We call it Mandrel Filament Moulding (MFM). The process is fully automated and computer controlled for ultimate accuracy, repeatability, efficiency and that stunning “Viper” pattern.

Seldén produce over 400 carbon masts per year as well as booms, poles and bow sprits for boats including high performance skiffs, racing keelboats, IRC race boats and some of the world’s most prestigious cruising yachts. With more sailors choosing Seldén carbon spars, the pattern is obvious.
Why go carbon?

All over the world Dinghy, Keelboat and Yacht sailors are enjoying the benefits of Seldén carbon spars for both racing and cruising.

- Carbon masts are lighter: less weight in the rig increases righting moment and reduces pitching for more performance and more comfortable sailing.
- Carbon masts are stiffer: improved control of mast bend improves sail shape and reduces forestay sag, more performance and higher pointing.
- Carbon booms are up to 40% lighter: less weight in the boat and on the mainsail leech increases performance. Lighter booms have less momentum making for easier and safer gybes.
- Carbon poles are lighter: easier to lift and easier to handle for faster and safer hoists, gybes and drops.
The Seldén system

- Pre-preg construction: all tubes are made using 100% pre-preg materials. No wet lay-up is used.
- Seamless tubes: using a male mandrel makes a single piece tube. The need for vertical joins and joints using screws and filler is eliminated.
- MFM: straight, thin filaments of carbon fibre are laid on a male mould.
- CNC: carbon is laid by a computer controlled head. Consistent, accurate, repeatable, no human error.
- Autoclave cured: superior consolidation and controlled curing.
- Choice of fibre modulus and finish quality.
- Composite boom brackets and removable carbon headboxes.
- Optimised fibre angle: fibre laid from 0 – 90°.
- FE Designed: Finite element software used for 3D modelling spar designs.

Cross section

- Seamless tube: no vertical join, no extra filler, no extra laminate, no glue.
- Autoclave cured for near perfect consolidation and void free laminate.
- Fibre is applied under high tension to ensure straightness and a compact lay-up.
- Zero degree longitudinal fibre provides extra stiffness where required to optimise bend and performance.
- Continuous fibre laid at the optimal angle (between 15 – 22°), to provide strength and longitudinal stiffness. No need for 45° fibre.
- All structural carbon is uni-directional pre-preg. No wet resin is used.
- Carbon filament has a low resin content compared to cloth or tape.
Give us the facts

At Seldén every rig is specifically designed and engineered for each boat. We base our mathematical dimensioning on data supplied by the yacht designer using our ‘rig facts form’.

This is used by our ‘Rigcalc’ team to calculate the righting moment of the boat which determines section size and rig loads. Every boat is added to a database which gives our designers an experience bank of over 10,000 rig designs.

In addition to this we have stringent policy of checking our calculations with heel tests. We started this practise in 1965 and continue it today. Materials and technologies change, good methods don’t.

Finite Element Analysis
In addition to the usual Rigcalc process our team of structural engineers can model carbon spars using the latest finite element analysis software. This software allows them to create a visual representation of a rig and then simulate the behaviour of different rig designs. They can even model the effect of different wind and wave conditions and the effect these will have on the structural integrity of the rig.

The use of this technology allows our Rigcalc team to further optimise the design and construction of our carbon spars. Together with our composite engineers they optimise the stiffness of each panel of the mast and strengthen the tube for every fitting.

Materials

100% Pre-Preg Carbon
All our spars are made from pre-preg meaning that the fibre is coated in the precise amount of epoxy resin for optimum lamination. This allows us to build a lighter, stronger spar because for a given weight we have a higher ratio of carbon to resin. No wet lay-up is used anywhere on our spars.

The MFM process uses carbon tow, a ribbon of carbon fibres held together by the uncured resin. The resin content of carbon tow is lower than carbon cloth or the uni-directional tape used in other production systems such as female moulding. This is not always the case with some manufacturers.

Resin Content

Typical % Resin Content

<table>
<thead>
<tr>
<th>Spars Type</th>
<th>Typical % Resin Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seldén Pre-Preg</td>
<td>31</td>
</tr>
<tr>
<td>UD Pre-Preg Tape</td>
<td>33</td>
</tr>
<tr>
<td>Pre-Preg Cloth</td>
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<tr>
<td>Infusion (Approx.)</td>
<td>43</td>
</tr>
<tr>
<td>Wet Lay-Up (Approx.)</td>
<td>45</td>
</tr>
</tbody>
</table>

Modulus of Different Fibre Grades

At Seldén we only use the best quality carbon fibre.
We use three different modulus of carbon that we call standard, intermediate and high. The higher the modulus the stronger the carbon so the lighter and stiffer the mast. Which modulus we use depends on the performance requirement of the customer. If you specify a high modulus Seldén mast it means all the fibre is high modulus.

<table>
<thead>
<tr>
<th>Fibre Type</th>
<th>Typical Fibre Type</th>
<th>Modulus Gpa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Modulus</td>
<td>T700</td>
<td>230</td>
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<tr>
<td>Intermediate Modulus</td>
<td>T800</td>
<td>294</td>
</tr>
<tr>
<td>High Modulus</td>
<td>M40J</td>
<td>377</td>
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</table>
Mandrel Filament Moulding (MFM)

MFM is a process unique to Seldén. Our custom made CNC fibre laying machines are fast, efficient and equipped with a delivery system designed and fitted by Seldén to provide the finished spar with unrivalled accuracy and precision. The key stages of the process are:

Winding
An aluminium male mould is rotated on the MFM machine. A carriage travels next to the mandrel that carries spools of carbon fibre and the delivery system. This has a series of feeding wheels, a tensioning system and a delivery wheel that lays the carbon fibre on to the mandrel.

Computer controlled
The number of layers and the angle at which the fibres are laid is controlled by the same design software that our composite designers and the Rigcalc team used to design the spar.

Shrink wrapping
When the lay-up is complete the delivery head sheathes the mandrel/carbon combination in heat shrink tape. It is then removed from the MFM machine, enclosed in a vacuumed bag and prepared for the curing process.

Autoclave cured
All Seldén carbon spars are autoclave cured. An autoclave is a pressurised curing oven. The secret to making a strong laminate is to use precisely the correct balance of heat and pressure to squeeze and cure the spar. Our system is computer controlled and runs a complex cure cycle to ensure optimum consolidation of the laminate.

Only the use of autoclave curing will guarantee a well consolidated and virtually void free laminate.

Extraction
Once cured the mandrel is extracted from the carbon tube which is ready for finishing.
Seldén carbon spars are available with a choice of 5 quality levels of surface finish. Which quality you choose depends on the type of boat and the requirement of the spar.

Spars can be supplied with a clear finish or painted the colour of choice.

**Natural:** Dinghy spars and spinnaker poles are supplied with no additional painted finish. The resin system used in the manufacture of all our carbon spars includes a UV inhibitor to protect the epoxy resin. A black pigment is also added to the resin to further improve UV resistance. A natural finish and the limited UV resistance it provides is ideal for spars where weight and cost are critical.

**Standard Clear:** In this process spars are fully sanded and painted with 3 coats of Clear UVR. The result is the deep shine viper pattern that makes our spars stand out. This is the standard finish for all keelboat and yacht spars.

**Standard Clear Plus:** With the plus finish 3 coats of epoxy primer are applied before re-sanding and 3 coats of clear UVR. This provides a deeper gloss and improved UV resistance that prolongs the life of the finish.

**Ultimate Clear:** For the ultimate finish 6 coats of epoxy primer are applied. The spar is then faired and coated with 3 layers of Clear UVR. The fairing makes a smoother mast surface between external patches.

**Standard Solid:** A solid finish provides far greater UV resistance than any clear finish. The standard solid finish uses 2 coats of epoxy primer that are then sanded and followed by a further coat of primer and 3 top coats.

**Standard Plus Solid:** Similar to the Standard Solid except a 4 coats of epoxy primer are used to allow fairing before top coats are applied. The fairing makes a smoother mast finish between external patches.

**Ultimate Solid:** 2 coats of high build are applied before the primer and top coat. This allows deeper fairing and an even smoother finish to the mast panels between the external patching.

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**Type of Spar**

<table>
<thead>
<tr>
<th>Natural Finish</th>
<th>Dinghy Spars</th>
<th>Keelboat Spars</th>
<th>Yacht Spars</th>
<th>Keelboat &amp; Yacht Spinnaker Poles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
</tr>
<tr>
<td>Standard</td>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
</tr>
<tr>
<td>Standard Plus</td>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
</tr>
<tr>
<td>Ultimate Clear</td>
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<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
</tr>
</tbody>
</table>

**UV Inhibited Clear Epoxy**

- YES
- NO

**Light Weight**

- Glass Finish
- Super Glass Finish
- Excellent UV Protection
- Good UV Protection
- Clear Finishes
- Choice of Colour

**Clear Finish**

- Smooth Panels, raised patching
- Choice of Colour

**Smooth Finish**

- Smooth Panels, raised patching

**Note:** Matt finishes and other custom options are available at customer request.
Carbon yacht masts are supplied with custom mainsail track which can accommodate both RGB cars for cruising and luff rope for racing. The track is bonded and riveted for extra security. Keelboat spars are fitted with an aluminium luff track for bolt rope as standard but can be fitted with RGB track as an option.

All Selden carbon yacht masts come with composite boom and kicker brackets. These are manufactured from pre-preg carbon and are bonded to the mast. Keelboat masts are supplied with light weight aluminium brackets.

Carbon Booms
A Selden carbon boom offers up to a 40% weight saving compared to aluminium. Our booms are made using the same MFM process as our mast and are available with the same choices of fibre and finish. Note that under IRC there is no additional penalty for a carbon boom if your boat already has a carbon mast.
Specialist fittings – booms

End Fittings
Inboard end fittings are machined aluminium. They have integrated slots to house a variety of sheave combinations all of which are recessed in to the boom tube.

Vang Attachment
High strength is provided by fitting a cast stainless steel tang to hand laid local carbon reinforcement.

Mainsheet Attachment
A simple but strong Dyneema loop passes through a composite tube in the boom. Stainless bushes are fitted to prevent wear.

Reefing Options
Booms can be supplied with conventional slab and single line reefing. Clutches can be integrated into the tube at the inboard end if required.

Outhaul
As standard a Dyneema outhaul line is supplied to be lead to the cockpit. On smaller booms and for racing applications an internal cascade system with a cam cleat and lead block at the inboard end is available.

Boom Lights
Can be fitted as an optional extra.

Seldén ‘Y’ boom

The Seldén ‘Y’ boom is a Park Avenue type carbon boom designed to allow easier reefing and sail stowage for the larger cruising yacht. Lazy jacks guide the sail on to the top of the boom while the beautifully shaped wings of the ‘Y’ boom help to catch and retain the mainsail when lowered. A sail cover is then zip closed over the top of the sail. Single line reefing and boom lights can be specified as options. ‘Y’ booms can only be supplied with a painted finish.

Outboard end showing outhaul track and car, concealed sheaves and pad eye for preventer.

Beautifully shaped tapered profile. Picture shows integral inboard end fitting with concealed sheaves for the single line reefing luff lines, integral track for the sail cover and pad eyes for lazy jacks.

Close detailing of the concealed inboard end sheaves.

Mainsheet pad eye faired in to underside of the boom.

LED boom light option.
Spinnaker poles

A carbon spinnaker pole is a popular upgrade for both cruising and racing sailors. Carbon poles are up to 40% lighter than an aluminium equivalent. This makes them much easier to handle during hoists, gybes and drops, as well as reducing line loads on the topping lift. Seldén carbon poles are available for boats up to 70ft.

Gennaker bowsprits

Seldén gennaker bowsprits are available as an easy to fit kit. A range of bow fittings are available to fit most boats which allow the pole to be easily extended and retracted. Complete pole and launch systems can also be supplied for fitting through the bow of the boat. These comprise a complete carbon pole, fibreglass launch tube for fitting through the topsides and all associated bearings.

Carbon section list

Seldén carbon Spars are produced in a wide range of sections spanning applications from racing dinghies and skiffs through to yachts up to 75ft. In addition to the profiled mast sections shown below Seldén can produce 20 different sizes of round tube used for spinnaker poles, gennaker bowsprits and launch tubes, as well as 10 different sizes of tapered round tube used for tapered spinnaker poles.

Seldén has a programme of continual investment in tooling and new tooling can be made to specific order. Please enquire for details.

Note that all dimensions are typical. The actual finished size of the section and wall thickness depends on the design of the individual spar.

<table>
<thead>
<tr>
<th>Section</th>
<th>Section dim. mm</th>
<th>Typical Wall Thickness mm</th>
<th>Typical Application</th>
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<tbody>
<tr>
<td>CC050</td>
<td>54/54</td>
<td>2.0</td>
<td>Dinghy Mast</td>
</tr>
<tr>
<td>CC064</td>
<td>64/62</td>
<td>2.0</td>
<td>Dinghy Mast</td>
</tr>
<tr>
<td>CC077</td>
<td>77/62</td>
<td>2.4</td>
<td>Keelboat Mast</td>
</tr>
<tr>
<td>CC086</td>
<td>86/68</td>
<td>2.4</td>
<td>Keelboat Mast/Boom</td>
</tr>
<tr>
<td>CC095</td>
<td>95/75</td>
<td>2.4</td>
<td>Keelboat Mast/Boom</td>
</tr>
<tr>
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<td>104/77</td>
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<td>CC115</td>
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<td>CC136</td>
<td>135/86</td>
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<td>Keelboat Mast/Boom</td>
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<td>CC154</td>
<td>154/87</td>
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<td>Yacht Mast/Boom</td>
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<tr>
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<td>173/93</td>
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</tr>
<tr>
<td>CC192</td>
<td>193/102</td>
<td>4.2</td>
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<td>CC244</td>
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<td>263/135</td>
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<tr>
<td>CC384</td>
<td>376/192</td>
<td>6.6</td>
<td>Yacht Mast/Boom</td>
</tr>
</tbody>
</table>

As standard they are supplied with a natural finish, clearcoat and painted finishes are available as an option. Protective Twaron wrap can be specified to reduce damage where the pole contacts the forestay.

Seldén gennaker bowsprits are available as an easy to fit kit. A range of bow fittings are available to fit most boats which allow the pole to be easily extended and retracted. Complete pole and launch systems can also be supplied for fitting through the bow of the boat. These comprise a complete carbon pole, fibreglass launch tube for fitting through the topsides and all associated bearings.

As standard they are supplied with a natural finish, clearcoat and painted finishes are available as an option. Protective Twaron wrap can be specified to reduce damage where the pole contacts the forestay.

Seldén carbon poles are available for boats up to 70ft. Larger poles are tapered at both ends. A range of fittings and rigging options are available.
The Seldén Group is the world’s leading manufacturer of mast and rigging systems in carbon and aluminium for dinghies, keelboats and yachts.

Our well known brands are Seldén and Furlex. The world-wide success of Furlex has enabled us to build a network of over 750 authorised dealers covering the world’s marine markets. So wherever you sail, you can be sure of fast access to our service, spare parts and know-how.

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