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UPFFRONT.COM FURLING SYSTEM OVERVIEW

INTRODUCTION TO CODE 0/GENNAKER FURLING SYSTEMS

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performance hardware & rigging

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CONTENTS

1. WHAT DO THE TERMS “TOP-DOWN” AND “BOTTOM-UP” FURLING MEAN? **3**

2. WHAT ARE THE DIFFERENCES BETWEEN BOTTOM-UP AND TOP-DOWN FURLING UNITS? **7**

3. FURLING CABLE SPECS – THE BASICS **10**

4. CHOOSING THE RIGHT FURLING UNIT FOR YOUR BOAT **13**

5. FURLING OPTIONS & ACCESSORIES **18**

1. WHAT DO THE TERMS “TOP-DOWN” AND “BOTTOM-UP” FURLING MEAN?

"Top-down" and "bottom-up" furling are expressions used primarily for continuous line furling systems using a torsional cable/rope, around which the sail furls. As opposed to a traditional foil furling system, used on cruising boats, where the jib/genoa is hoisted in a luff groove in the aluminium foil and the sail furls around the full length of the foil. The name “Continuous Line Furler” refers to the fact that furling is achieved around a low profile drum using a continuous loop, or endless, furling line.

Bottom-up Furling

Continuous line furlers have evolved in line with the popular growth in the use of Code Zero sails. The Code Zero is a relatively deep, lightweight, reaching sail. It is referred to as a "straight luff" sail where reasonable luff tension is required to enable pointing. The torsional cable is enclosed in a pocket which runs up the luff of the sail.

Bottom-up – the Tack of the sail is lashed to bottom thimble of torsional cable (Image courtesy of Facnor Furling Systems)

The sail is lashed to the thimbles of the cable at both the tack and head. The cable sits with the sail in the sail bag, already tightly furled. When it comes time to deploy the sail, the cable thimbles are attached to the jaws of the furling drum at the tack and a swivel at the head, hoisted as a long sausage and tightened. To unfurl, the continuous line drum is allowed to spin freely until the sail is fully deployed. When it comes time to furl away the Code 0, as the furling drum starts to turn, it starts to wrap the bottom of the sail around the cable first and the furl gradually works its way up the luff of the sail - hence the expression "Bottom-up".

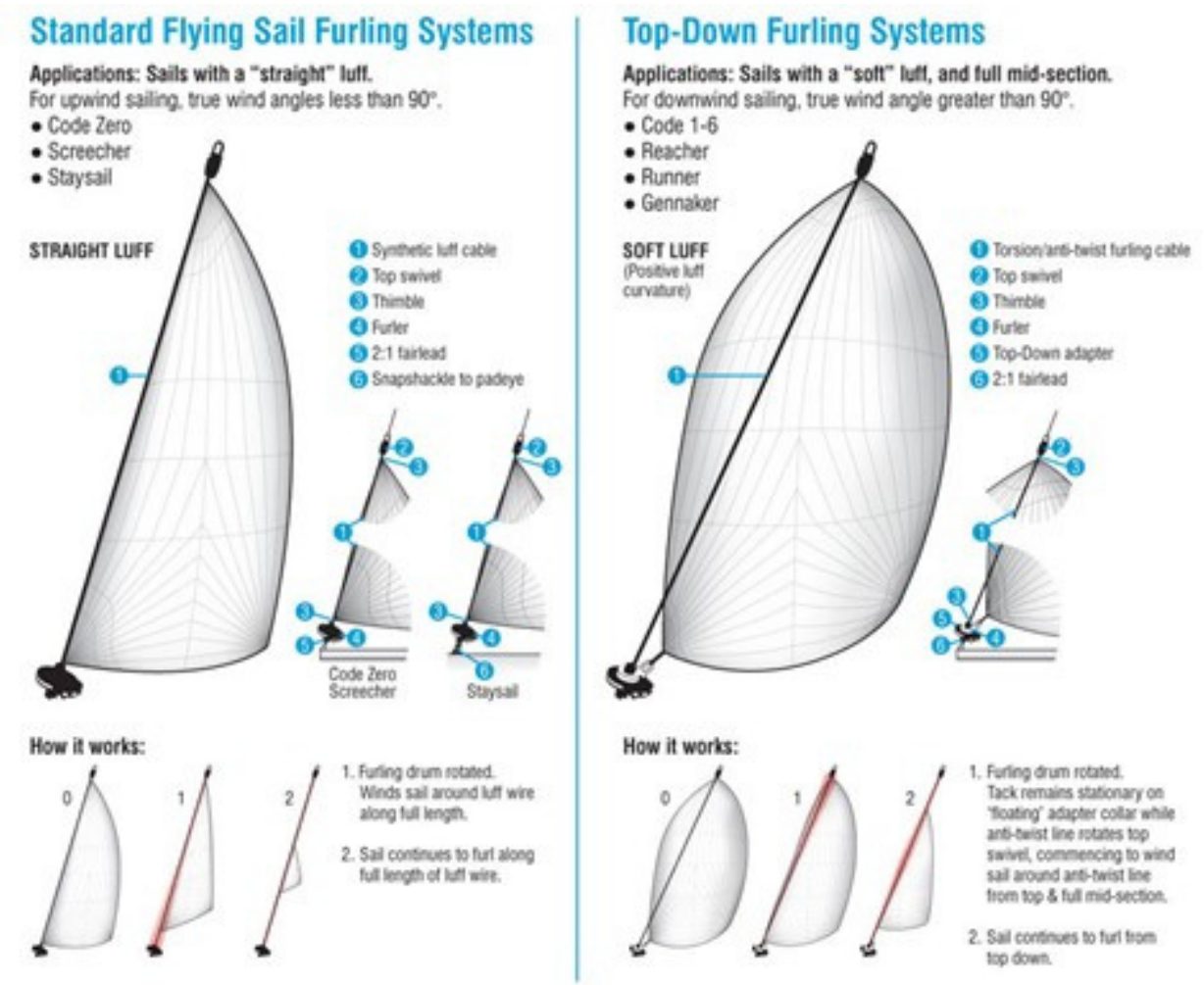


Image courtesy of Ronstan

Top-down furling

The emergence of top-down furling is a much more recent phenomenon. As Code 0's became more popular, so too did asymmetric spinnakers, particularly in racing circles where they were looking to optimise their downwind sailing angles. Asymmetric spinnakers are really an extension of the code zero, they just get deeper and lighter as the desired sailing angle becomes lower. However, there is one fundamental difference between an asymmetric spinnaker and a code 0: as you sail deeper you want the whole sail to be able to rotate around the forestay plus you achieve greater sail area with more positive luff curve compared to a tighter reaching sail which requires a straight luff. Therefore, asymmetric spinnakers require a “free flying” luff which is independent from the furling cable.

The traditional method for dousing a spinnaker was a snuffer but with the increasing use of bottom-up furling for code zero's, and their similarities to asymmetric spinnakers, people started to experiment with continuous line furlers. Initial attempts at standard bottom-up furling proved disastrous! Due to the depth of the sail, the furl would start at the bottom, but before the centre of the sail was furled away, it would also start furling from the top-down, leaving a large pocket of air trapped in the middle of the furled sail.

Top-down – The Tack of the asymmetric remains still, on a free-floating swivel, while the drum turns and transmits torque to the head of the sail. (Image courtesy of Karver Systems)

There is plenty of debate about who actually started the top-down furling craze, but the solution to effectively furling away these deep downwind sails was to allow the furl to start at the head and leave the tack of the sail to rotate freely at the bottom, unconnected to either the cable or the furling drum. The result: the furl is transmitted from the drum, along the full length of the torsional furling cable and starts at the head of the sail and all the air is squeezed out of the sail as the furl travels down the cable to the tack.

SUMMARY

- **Bottom-up furling**
  - Straight luff code zeros and staysails - reaching sails
  - Torsional cable contained within a luff pocket in the sail
  - Sail attached to both top and bottom of the cable
  - Furl starts at the bottom and works its way up the luff of the sail

- **Top-down furling**
  - Loose luffed asymmetric spinnakers - running downwind sails
  - Sail is attached to the cable at the top but allowed to rotate free from the cable, or drum, at the tack
  - The furl starts at the head of the sail and works its way down the cable

2. WHAT ARE THE DIFFERENCES BETWEEN BOTTOM-UP AND TOP-DOWN FURLING UNITS

What are the key differences between bottom-up and top-down furling units and do I need a dedicated unit for each type of furling?

Dedicated Top-down unit

The primary difference between a bottom-up and a dedicated top-down furling drum is that a top-down drum has the addition of a free-floating tack swivel mounted on the furling drum. When the drum is furled, the fork and cable are rotated whilst the tack swivel remains static. This allows the torque to be transmitted along the full length of the cable to the head of the sail where the furl starts. With the free floating asymmetric spinnaker tack, the bottom of the sail is then the last part to be furled around the torsional cable.

A top-down drum is heavier than its bottom-up counterpart due to the addition of this tack swivel. It should be noted that some manufacturers specify a separate working load for the tack swivel, much lower than the Safe Working Load (SWL) of the furling unit itself. Having said that, with top-down furling, SWL is rarely an issue because the cable is only tensioned during furling / unfurling and even then, with just enough load to hold the cable straight during the furl rather than under serious tension.

Note: a top-down furler can be used as a standard bottom-up furler, the tack swivel just becomes superfluous.

Other options?

Top down Adapters

Furling units are a reasonable investment and so most will be pleased to hear that there are some options, other than buying a dedicated top-down furling drum.

Most common of these, popular amongst cruising and increasingly racing sailors, is to use a top-down adapter. This is a stand-alone tack swivel that has an eye to connect into the fork of a standard bottom-up furling drum with an upper fork into which the torsional cable is connected.

The top-down adapter can be set up and left permanently on the sail, with the cable connected and tack lashing in place. With a swivel, similarly dedicated and stowed with the sail, when it comes time to hoist your gennaker, simply attach the top-down adapter in the jaw of the drum, attached the halyard to the swivel and hoist out of the bag.

Above: Two examples of a top-down adapter from Facnor (left) and Karver (right)

The only disadvantages with the top-down adapter are the increase in weight, over a dedicated top-down drum, and a slight decrease in available luff length. However, for most sailors the advantages of using a single drum for both their code zero and downwind gennakers outweighs the disadvantages.

Tack lines

Another, slightly more complicated, option is used on a number of big boats, with the crew and brain-power to pull it off! In reality, the tack of the asymmetric spinnaker can be completely independent to the furling drum. Some boats set up a 2:1 tack line directly onto a padeye on the deck, close to the drum. For the hoist, the swivel is attached to the halyard, the bottom of the torsional cable to the fork in the drum and then the tack to the line onto the deck.

The advantages of this setup are that it is the lightest option and it allows the crew to quickly and easily adjust the luff tension on the gennaker. The downside is that you do need to ensure the tack line trimmer is paying attention during the furl/unfurl manoeuvres!

SUMMARY OF AVAILABLE OPTIONS:

- Separate, dedicated bottom-up and top-down furling units
  - Expensive
- Use a top-down adapter on each of your gennakers together with a single, standard bottom-up furler
  - Heavier, but a very flexible and efficient set-up
- Use a dedicated top-down furler for both bottom-up and top-down furling
  - Slow sail changes but otherwise perfectly acceptable
- Use a bottom-up drum with a separate asymmetric tack line
  - Need to have experienced crew

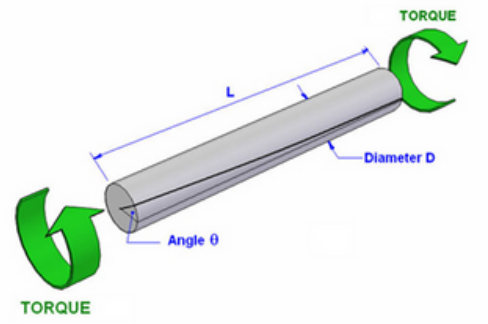
3. FURLING CABLE SPECS – THE BASICS

What's the difference in design between a top-down or bottom-up torsional cable? Find out what makes a good torsional cable and the important differences between the two applications.

They might look the same but a top-down furling cable requires a fundamentally different specification to that of an equivalent length bottom-up cable. Top-down furling cables are more expensive and there may be a temptation to go for the cheaper, bottom-up option. But you do so at your peril ..... as failures can be expensive!

What makes a good torsional cable?

The secret to torsional performance is in the covers of the cable. A variety of techniques are used by different manufacturers but, in essence, the covers are designed to act like a torsional tube, around the core fibre, which carries the tensile cable load. Torsion is a function of the force applied by the distance (r) from the axis of rotation, which for a cable is its centre. Therefore, torsional force increases relative to the diameter of the cable. The trick with a good torsional cable is to maximise the torsional stiffness but still retain overall cable flexibility to allow it to be stuffed into the bag, with the sail, when not in use.



Bottom-up

Bottom-up cables are relatively highly loaded to ensure good luff tension in your straight luffed code zero or staysail. Therefore, cable stiffness is a key performance parameter together with minimum diameter to reduce upwind drag. This is why PBO is one of the optimum core materials for bottom-up furling cables on GP race boats, being the stiffest, lightest and smallest diameter soft composite fibre available on the market. Dyneema® SK99 is increasingly matching the performance specifications of PBO cables and is also a much more durable material.

Good torsional performance is obviously also required, however, as the furl starts at the bottom of the sail, within a few turns the tack of the sail has rolled onto itself and the sail luff starts to assist in the transfer of torque up the cable. As the sail luff adds significant diameter to the cable, it contributes significantly to the effective torsion of the overall cable/sail furling system.

Top-down

Top-down cables used on loose luff, downwind sails, spend much of the time slack and should only be fully loaded during furling and unfurling. As the furl starts at the head, the torque has to be transferred from the drum, along the full length of the cable without any assistance from the sail. In addition, due to the larger sail area of gennakers, speed is a critical success factor for top-down furling. High torsional loads and high speed mean that torsional performance is THE most important characteristic for a top-down cable.

With relatively low working loads, the core fibre's only role is to be light and fat to provide diameter to support the cable covers which are doing all the work. This is why Dyneema® offers an excellent choice for the core of a top-down cable. It is one of the lightest and strongest fibres on the market which allows you to build diameter without a weight penalty. Gottifredi Maffioli goes one step further in the pursuit of building low-load, lightweight, large diameter top-down cables by using a hollow filament called Aircore at the centre of the cable, surrounded by Dyneema® and then the outer covers to deliver the torsion.

SUMMARY

- **Bottom-up cables** need to be **stiff, thin and light** whilst still delivering reasonable torsion
- **Top-down cables** are all about **torsional stiffness** and need maximum diameter without adding too much weight.

Image courtesy of Bamar

4. CHOOSING THE RIGHT FURLING UNIT FOR YOUR BOAT

How do I choose the right code zero or asymmetric spinnaker furling unit for my boat? Data from a number of well-known manufacturers is reviewed and conclusions drawn to help guide you to an appropriate unit for your needs.

A quick review of the available data will tell you that sizing the correct furling unit for your boat is NOT an exact science!

The correct method for specifying a unit is by the Safe Working Load (SWL) and this is the one consistently available piece of information, across all manufacturers. Unfortunately few, if any, people really know the SWL of their forestay or their Code zero tack load.... and manufacturers cannot agree on the boundaries!? For example, Facnor, Karver and Harken all have code zero furlers with an SWL of 1500kg. At this load, Harken suggest a maximum recommended boat size of 33ft, whilst Karver push the boundary out to 36ft, and Facnor go all the way up to 39ft.

However, do not despair. It is possible to generalise, based on boat size, to get a ballpark SWL and then consider a number of variables to guide your final decision.

First cut based on Boat size

Summarising the data across a number of manufacturers, here at Upffront, we use the table below as an initial guide to required SWL based on your boat size. See table below:

Boat Size (ft)	SWL (kg)
18	500
25	750
28	1000
35	1500
38	2000
41	2500
45	3000
49	4000
56	5000
60	6000
70	8000
80	10000
90	12000

As an example, if you have a 46ft boat you should be looking for a furling unit with a SWL of 3000-4000kg, whilst a 50-53ft boat might require something in the 4000-5000kg range.

Other Considerations

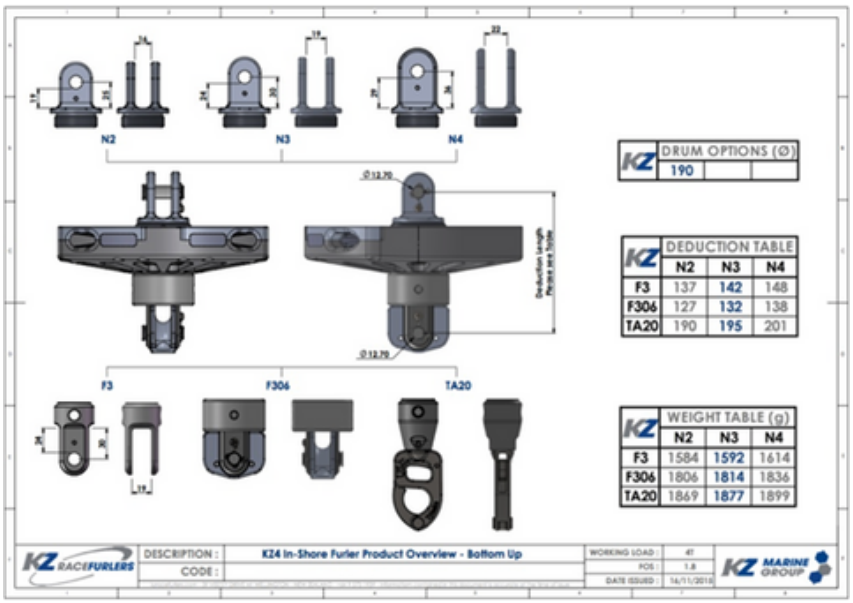
Ok, so we have a starting point but what other factors should be considered:

- **Displacement and sail size**
  - If you have a particularly heavy displacement boat and/or particularly large and powerful sail then you might consider a slightly larger unit
  - If you have a multihull this will almost always push you into the next category up due to the increased stability and therefore, loads.

- **Staysails**
  - Due to the significantly smaller sail areas relative to code zeros and gennakers, on the same boat, Staysail furlers can often be a size down. However, a general rule of thumb is to use the same size as the code zero which reduces the number of furlers you need and/or build in some redundancy.

- **Do you have an existing sail / furling cable?**
  - If so, the thimble width on your furling cable is critical to the specification of the unit.
  - Various jaw widths and pin sizes are available across the different unit manufacturers but this will limit your choice to a small number of suitable units
  - Please do not forget jaw depth i.e. the distance from the pin to the back of the jaw. It is by no means guaranteed that this distance is enough to accommodate your thimble/cable.

- **Top-down or bottom-up**
  - Despite the obvious choice of whether to go for a dedicated top-down furling unit, top-down furling has other consequences on unit size
  - Loads are much smaller for top-down furling and therefore, in theory, you should be able to go down a size
  - **However**, cable sizes are always bigger in diameter, relative to bottom-up cables. This drives bigger thimble widths which often forces you to buy a larger furling unit than is required for top-down, based on pure SWL requirements.
  - Only a small number of manufacturers appear to have optimised their ranges for the specific needs of top-down furling.
    - However, one good example is KZ Racefurlers from New Zealand where every unit is available with a range of jaw sizes - to allow a smaller SWL unit with a larger than normal jaw width, to accommodate a larger thimble.
    - But this flexibility does come at a premium price...!



KZ Racefurlers with multiple jaw width options

- **Drum diameter**
  - If you have narrowed your selection down to a few possible options, drum diameter is another important consideration
  - A bigger drum provides more **More torque** / power which will be useful for a heavier / larger code zero
  - A smaller drum delivers **More speed** - an essential component to successful top-down furling
    - Remember: the smaller the drum the more power and line speed you need to generate from either your winches or your arms (depending on boat size)!

- **Lock or no Lock**
  - Furling drum locks / ratchets are becoming increasingly popular but they are by no means standard across the manufacturers.
  - Code zero's and asymmetric spinnakers are always either fully furled, or fully unfurled (never partially reefed), and historically people have been content to tie, or cleat, off the furling line when the sail is furled
  - However, increasingly customers like the security of using a lock to prevent the accidental unfurl.
    - But it should be noted that drum locks are designed as temporary safety features and not designed to hold the sail furled for long periods

Image: Facnor - “Click” Ratchet

Finally, having considered all the factors above weight is also always a key decision criteria and this is no less important for cruising boats. Saving weight should be on your mind in every hardware and rigging choice made on your boat. Lowering the overall weight of your boat makes it stiffer and more powerful / responsive, but also reduces the overall rig loads. This in turn, increases safety factors, reduces ware, and ultimately increase the life of your hardware and rigging.

Summary

The following checklist is roughly in order of importance:

- Identify a suitable Safe Working Load (SWL) range based on your boat size
- If you have a multihull - go one category up
- Is your displacement or sail particularly large/small which may influence the SWL above or below these average recommendations?
- If you have an existing torsional cable - consider jaw width/depth and pin diameters
- If it’s for top-down you need to minimise SWL but consider all the other important criteria for effective furling and be prepared to accept the larger unit size
- Check your options on drum size and consider lock or no-lock
- Finally choose the lightest one

5. FURLING OPTIONS & ACCESSORIES

When purchasing a furling system, there are several other considerations that need to be taken into account to ensure you have a fully operational furling system. Some are basic / essentials and others are optional extra's.

Tack fitting

Most drums come with either a D-shackle or snap shackle, however not all, so please check what comes as standard with your drum. If you plan to store the drum with the sail, then a snap shackle will the simplest and most efficient solution. However, if you plan to position your drum and leave it on deck for use with multiple sails then a standard D-shackles would be adequate.

There are other options, specifically for use in conjunction with locks – see section below.

Head fitting

Most swivels will come with a D-shackle as standard. The primary consideration is whether you want to go for a 2:1 halyard setup.

The advantages of 2:1 halyard are:

- Reduces the effective weight of pulling up the sail
- Reduces the compression in the mast
- Reduces load on fittings
- Less load in the halyard clutch
- Allows the use of a smaller halyard

Disadvantages:

- 50% increase in halyard length
- More halyard to pull through for the hoist
- More halyard to store when hoisted
- Replacing the halyard requires a trip up the mast

Some swivel manufacturers provide dedicated/integral 2:1 block options, however, it is possible to just lash a suitably sized block to the D-shackle on the swivel.

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Drum lock / ratchet

Continuous furling line systems, with a torsional cable, are not designed to be used partially furled. However, there is nothing more frustrating than losing the grip on the furling line 70% of the way through a furl and the whole thing unspinning in a flash! It is for this reason that ratchets, or drum locks, are an increasingly popular accessory.

Some manufacturers provide a removable drum lock as standard whereas others require a modified drum, so it is something that needs to be considered at the outset.

Furling line

Essential, but easy to forget! Your continuous furler needs a continuous furling line – an endless splice creates a loop of 6mm, 8mm or 10mm line. It is important to get the correct diameter line for the drum as the furling system relies 100% on the grip of the rope around the drum.

Regardless of whether you are racing or cruising, a quality furling line with a tight cover is essential to ensure smooth running of the furling unit at all times. A loose cover building up at the entrance to the furling unit, causing a jam, can mean losing places at the bottom mark while racing but also creates a potentially dangerous situation if you cannot furl away a sail, just when you need to.

In addition to choosing a decent furling line there are several setup choices you need to make.

- Foredeck or cockpit operation
- On smaller boats where the unit can easily be furled by hand it is quite common to use a shorter furling line with a crew member furling from the foredeck
- For short-handed sailing or on larger boats, the furling line is generally lead back to the cockpit where it can be put on a primary winch.
- Shock cord take-up
- Both foredeck and cockpit systems are often set-up with a shock cord take-up to keep the line neat when not in use
- This consists of a simple piece of shock cord and a snatch block (allowing the furling line to run through it) which is tied back on at the mast base or pushpit.
- Lead blocks
- Cruising boats will often run their furling line along the stanchion bases and there are a variety of double fairleads available on the market.
- However, these units tend to come on/off with the sail and whilst the drums are setup for quick/simple removal of the furling line from the drum many prefer to run the furling line direct, without lead blocks and use the shock cord to keep it clean.

Swivelling halyard locks

An increasingly popular option, as more product variety becomes available on the market, is a furling lock. Locks have several advantages:

- Reduced compression in the mast
- Smaller halyard / hoist line
- Less load and wear on halyards, sheaves and clutches
- Fixed / consistent hoist height

Images: Karver KFH Swivelling lock,

The main “perceived” concern about using locks is getting the sail stuck aloft, however, technology has moved on considerably in recent years and race boats and superyachts can have many years of trouble free use. And with a code zero / asymmetric furling lock, a problem with lowering the sail is not a particularly dangerous issue, assuming the sail can be furled.

Without a lock, the halyard is used to provide varying halyard tension. With a lock in use, an additional 2:1 or 3:1 purchase system is required between the drum and the deck to achieve the required load in the system. All the furling unit manufacturers have fittings for the bottom of the drum to allow for 2:1 or 3:1 purchases.

Karver 3:1 Friction sheave,

Conclusion

The trend from the old, traditional, 150% genoa plus symmetrical spinnaker setup to smaller, easier to handle, jibs plus code zeros and asymmetric spinnakers continues to gather pace. Race boats have led this transition, but it is cruising boats, big and small, that are reaping huge benefits in terms of ease of handling and pure sailing enjoyment. There are a large number of high quality products on the market to choose from and we hope this guide has gone some way to helping you understand some of the main decisions involved in finding the right product for your needs.

If you have any questions about code zero or asymmetric furling systems you can contact us at support@upffront.com or by clicking the link below:

Code 0/Gennaker furling systems