Benefits and selection of a good mainsail handling system

by NORMAN LONGWORTH CPEng

AFTER a good headsail furler and a reliable engine the most important asset for the cruising or racing/cruising yachtsman is a good mainsail handling system.

The main has to **go up easily** and **come down quick and safely**. It also has to reef easily and shake out reefs with minimum effort, this is also important for a serious racer with today's big mainsails. Most cruisers will opt for lazy jacks and a zip up cradle cover.

This gear will save fuel and money, when it is nearly as easy to set a main as to start the engine.

The multihulls with no backstay and full length battens supporting massive roaches have set a standard as in some cases it is nigh on impossible to lower or reef the main without good luff hardware. The first cost of this equipment has reduced over the last 12 years and the performance greatly improved with the serious competition for Australia's multihull business. It is now possible to fit a good system that will cost less than a mainsail and outlast two or three sails. This also applies to small monohulls. which are frequently sailed short handed and whose safety can depend on getting rid of the mainsail quickly.

The main choice is between a good slider system and a Recirculating Ball System (RCB). There are a number of trackless systems, some of which work well if the boat is head to wind. The track systems however can give low friction even with a heavy wind load in the sail.

The mast track is an expensive, but longest lasting component, which is a nuisance to replace. It should be selected so that more than one manufacturer's cars will fit it. This means that if a manufacturer ceases to produce cars or if

Bagatelle.

you need a car in a hurry you will have more than one option. The track should also suit both RCB and slider cars. To buy an orphan track does not make good sense!

Benefits of Sliders

Sliders are simple

You can drop them off the mast track without fear of losing balls;

They have no ends, normally giving lower stack height;

With modern materials they have little wear and very low friction;

The cars are narrower, as there is no ball return groove required;

They are relatively insensitive to dirt or salt crystals;

Best system if 'web on cars' are acceptable.

Benefits of Balls

Surprisingly most Ball cars are stronger providing they use TORLON BALLS;

Dirt problems and sticking must be designed out;

They do have lower friction;

They have almost infinite life;

With a good sail separation system, sails can be changed with little effort.

If there is no separate track for storm trysail (an essential for serious long distance cruisers) a high gate can be used above the stack. This is opened after the stack is screwed down.

At this stage I must declare my vested interest. I am the principal of an Australian firm that has specialised in the design and manufacture in Australia of RCB travellers and Low Friction Sliders for over 12 years. We focus on function and value rather than fashion.

Cost

In an effort to persuade the everyday yachtsman to invest in a good batten car system most manufacturers have kept prices down, this has increased the market by making good systems affordable, which in turn increased quantities and lowered production costs. In fact a top line RCB Batten Car system costs less today than it did 12 years ago.

Prices may at least follow general costs up in future. Labour and material costs are racing up after some years of stability. Due to small number of units, low labour content and substantial technology input, it seems that production of this equipment will not migrate to low labour cost countries as has happened, for example, with sailing clothing.

Despite all this, many boat owners overspend their budget and wish to start sailing at the minimum cash outlay. Many of these start with a good web on slider system and later upgrade to RCBs with solid batten connection, hence the importance of the right initial track selection.

Typically a 10 metre monohull (P=12 metre) costs $1260. Subsequent upgrading to an RCB System with solid batten connections $1340. At this price why struggle and risk being caught in a line squall with a new sail half down. Destroying a new mainsail costs a lot more than a top of the line luff hardware system!

Dirt

This has been the curse of ball cars. It is the prime cause of breaking plastic end caps, not impact. We confirmed this by using glass reinforced caps which do not break, but balls can jam with dirt.

Factors effecting dirt sensitivity

1. Ballsize;

2. Car length;

3. Manufacturing tolerances and clearances;

4. Ball 'catcher' geometry;

5. Lubrication/cleanliness of balls and track;

6. Type of ball.

It is improper to publish details of every manufacturer's techniques, but the following commentary is an overview of some of the differing methods. As usual, design is a compromise and everyone has a different solution, each with its own benefits and disadvantages.

Ball size has two effects. The larger ball like a larger wheel goes over the bump better. More importantly a larger ball makes for better ball 'catcher' geometry for the same clearances and tolerances. Unfortunately larger balls make a bulkier (wider) car and increase the weight, stack height and cost for the same strength.

Anyone, particularly mast makers, who have experience with aluminium extruders will understand the dilemma on **tolerances and clearances.** So long as the extruders product meets their 'Standards' you pay for it. Too bad if it won't do the job and the minimum quantity is half a tonne. Fortunately there are a few specialist extruders who run small quantities and can hold tight tolerances. Australia is blessed with one extruder who will produce track to machine shop tolerances, albeit at a substantial price. If the designer can not trust the dimensions of the track, he must increase the car clearances. This allows the car to wobble destroying the ball catcher geometry. If the balls are dirty they jamb, slide and wear flats. Longer cars tend to be more stable than short cars.

Harken has a **patented retainer wire** Probably more importantly it gives excellent ball catcher geometry. It does need a groove in the track for the retainer wire, which has drawbacks.

Frederiksen seem to rely on the **machining of car bodies** presumably to close tolerances. This is an expensive alternative to using extrusions.

Windslyce uses a patented **TEFLON 'lubricating' ball**. This is simple and seems to work well with crews too lazy to wash cars regularly. The balls stay clean and shiny without attention. We have licensed the use on other manufacturer's

cars with the same success. We also use at least one PTFE wiper car per luff system to keep track clean.

Under no circumstances should oily lubricants be used. These accumulate dirt including salt crystals. We have a label **'Lubricate with water'**, but lubricating with most silicone and PTFE sprays including MACLUBE seems to give good results.

We only use TORLON Balls, which are used by most other manufacturers at least for high grade cars. TORLON is an exotic engineering plastic with a compressive strength similar to aluminium but is more resilient, spreading the load over a larger area of the hard anodised surface. They are moulded at very high temperature before being ground to accurate dimensions and surface finish. They are not cheap, but so far they seem to be the best. A number of manufacturers are experimenting with other materials for balls both in car and sheave bearings.

The first known RCB car on a yacht, we believe was the mainsheet car on *Dame Pattie*, Australia's second challenger for the America's Cup in 1966. That car designed in Warwick Hood's office used stainless steel car, track and balls. It performed well. Harken seems to have introduced the TORLON ball, which allowed a high load car to run on hard anodised surfaces, with substantial weight savings.

There have been many refinements since and development is still progressing.

For a long time solid aluminium car ends were expected for high load applications. In our large 40mm (six tonne) track units we have used these as standard. Following some 11 years of successful experience with Glass Reinforced Plastic ends on our smaller cars, we are about to go away from metal ends. Metal ends are expensive, and destroy the track if cars are run without balls!

We seem to be the only manufacturer of a patented composite car. Very light and strong, fits standard 22mm track. Available in both deck and FBM versions.

Amer Too. (left)
Blithe Spirit. (above)

Connection of sail to car

The connection of the batten end to the car is of major importance. It is where money can be saved or wasted. To some extent the sailmaker sets the scene, he decides on battens, batten end and in conjunction with owner if the battens are luff or leech loaded, luff or leech adjusted, the thickness of batten at the luff, which sets the load on the connection.

We favour leech loaded, luff-tension adjustment, rectangular tapered battens, but in most cases we just follow the customer's instructions.

The cheapest solution is to web the batten end directly onto the car. This is not very durable and can put asymmetric loads onto the car.

In Europe a threaded pin connection is popular, usually M10 or M12. We do supply this connection but prefer plain pins as they are less likely to fatigue. In high load applications we use high tensile stainless steel pins. The worst loading on this horizontal pin is from motor sailing in calm conditions with the sail flogging.

There should be a simple system to separate the sail from the cars, without taking cars off mast. In most cases this is a removable vertical pin. However in systems on small boats where the smallest mast to luff gap is required more innovative systems are used.

Track fastening

A critical part of installation. There are four systems in common use.

1. Slugs in mast groove with tapped holes for track screws;
2. Drill and tap mast;
3. Slide in track to fit mast groove;
4. Integrally extruded track with mast section;
5. Glue track to mast.

Slugs in mast, the most expensive, but probably the lightest, best and certainly the most flexible. The only solution for fitting track to mast standing in the boat. With future large mast sections extruded in Australia, the back groove of the mast is a 7/8" standard groove. This will increase the manufacturing volume of buttons or slugs and should lower cost. This will help the adoption of this system.

Drill and tap is the cheapest, but strength depends on quality of tapping and thickness of mast wall. For a tapped hole in aluminium taking a stainless steel screw, the thickness should be twice the screw diameter to give full strength. In the event of replacing a damaged section of track it is difficult to guarantee track and mast holes will line up. Imagine being in a bosun's chair 30 metres up juggling screws, with a 25 knot breeze! It has been done.

A number of mast makers have their own track sections which they slide up the mast groove, usually 7/8" (22mm). They have developed techniques to stop track rattle.

Integrally extruded track is certainly the strongest, but as mentioned above maintaining tolerances is a nightmare. If

track is damaged, repair is difficult particularly in remote locations.

We have not had much experience with gluing track to mast. It is an obvious solution for the technically avante garde and very suitable for high performance composite masts. This can be in addition to, or in lieu of drilling and tapping into an inserted metal tapping bar.

Strength of system

There is some divergency in thinking on this subject. For racing boats, which will have a strong crew who can handle failures, lighter equipment can be tolerated. But remember most racing boats are delivered short handed and as they become obsolete tend to fall into the hands of less experienced crews.

Ben Lexcen said if a fitting broke it was too light, if it didn't it was too heavy.

The philosophy we use, unless specifically instructed to the contrary, is to focus on the headboard system. We do not wish a headboard carrier or the track fastenings by way of the headboard carrier to fail. There maybe some distortion but the mainsail must come down.

The worst loading this system is exposed to, is when mainsail is deeply reefed, ie. 50% down on luff.

On a monohull the headboard must take the boat through its maximum righting moment. For a catamaran it must lift a hull. The batten car loads depend on batten sizes and strength. Intermediate cars can be heavily loaded, particularly when luff is slack ie. during reefing. Another load which can cause problems is furling load due in part to batten torsion. Remember with large boats having a main weighing 200kg plus, the sail hangs off the luff cars during removing and replacing sail on the mast.

Summing up

- Go for a system with a track that takes cars of different manufacturers.
- If using sliders either as intermediates or batten cars, use sliders, which clean the ball track.

Cut Loose.

WINDSLYCE has PTFE rods similar diameter to balls.

Don't forget the trysail.

Think out mainsail changing.

Improve your sailboat enjoyment. Install a good mainsail luff system and lazy jacks. •