April 2018

SAILSetc

Miscellaneous Information - MI02A

SAILSetc Boat Notes

These notes were supplied to purchasers of SAILSetc boats of all classes. SAILSetc no longer supplies boats but they may remain helpful. The specification of, and construction techniques used in, SAILSetc designed boats built by other builders will vary from what is described here. For information relevant to any SAILSetc designed boat supplied after 2014 please refer to the builder.

There are notes common to all classes:

- *warning concerning 2.4 GHz rc receivers*
- *general notes applicable to all classes*

There is one section applicable to each class:

- *RG65 – notes specific to this class*
- *IOM – notes specific to this class*
- *M – notes specific to this class*
- *10R – notes specific to this class*
- *A – notes specific to this class*

There is a section covering maintenance

- *background information concerning our hulls and mouldings, their use and care.*

We recommend reading through these notes before you start to work on the boat.

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1 notes common to all classes

1.1 2.4 GHz transmitter/receiver systems

1.1.1 warning

SAILSetc has no experience with equipment that operates on the 2.4GHz band. We understand the new 2.4GHz band will give the end user a perfectly reliable, even totally superior, performance in terms of security and ease of use compared to existing model control bands. As with most new technologies there can be potential problems which are not always apparent when such equipment is applied to new applications.

SAILSetc does not warrant that such equipment is suited for use in carbon hulls where the possibility of shielding of the receiver aerial(s) exists. Installation of such equipment into your boat by SAILSetc or its subcontractors does not indicate its suitability.

You should satisfy yourself that the equipment is suitable for use in carbon hulls before acquiring it and thoroughly test the working of the equipment before using the boat.

Suppliers of the equipment will be in the best position to advise on its suitability and installation.

The following notes that relate to rc equipment assume it is conventional (not 2.4 GHz) equipment.

1.2 introducing your boat

1.2.1 aerial – external

Carbon hulls mask the signal to the aerial very effectively so an external aerial is necessary on our carbon boats. On glass boats it is still good practice to keep the aerial away from other cables in the hull. This helps protect the receiver from unintended signals. It is intended that the aerial shall be erected in the skin fitting when sailing. This gives the aerial its best performance. A maximum length of around 300 mm seems long enough to avoid all reception problems (not needed for 2.4 GHz equipment) even though theory indicates the aerial should be longer. This is probably because the equipment is always working well within its capabilities.

1.2.2 aerial - internal

The aerial cable fitted in the hull should be terminated with a Futaba socket. It has been our practice to connect all three cables on the socket to the single aerial cable. This maximises the connection to a Futaba plug connected to the receiver. You should also connect all three cables on the plug to the single aerial cable on the receiver.

This method allows the receivers to be removed easily from the hull and spare receivers to be substituted with the minimum of effort. All your receivers and boats should be compatible with each other allowing maximum flexibility.

1.2.3 screw top pot

If an electrical cable is trapped under the rim when the lid is tightened then a good seal will not be made and your cable may be damaged. Avoid this situation by ensuring nothing is fouling the closing of the lid, tightening it properly, and marking the centre of the front of the pot with a marker pen to show where the lid should be when it is tightened properly.

It is possible that there are slight irregularities in the upper rim of the pot that permit water to pass through. These may be present from new but can be caused by damage from trapped cables, tools, foreign objects. Check the rim of the pot and use a block of flat timber covered with 400 grade wet and dry abrasive paper to smooth the edge. Then use a small piece of 600 grade abrasive paper to round the upper edge in section. This will enhance the seal made by the rim of the pot on the wadding. If the wadding is damaged, turn it over or ask us for a replacement lid.

Do not apply Vaseline or other grease-like materials to the thread of the lid or pot as it will only attract grit and dirt and stop the lid from sealing correctly.

It may be helpful to add some Velcro to the inside of the pot and the back of the receiver so that it is held to the side of the pot. This helps during replacement of the battery.

Use Blutack to seal the hole in the side of the pot through which cables enter it.

1.2.4 before switching on your rc

You should remove the servo arm and the winch drum before switching on your transmitter. This will avoid the possibility of damage if the arm and drum are not aligned properly.

With the transmitter stick for the rudder at the central position add the arm to the servo so that it is at 90 degrees to the servo/tiller connector. The tiller arm should also be at 90 degrees to the servo/tiller connector. If it is not you can lengthen or shorten the servo/tiller connector, item 66d, by rotating it as it is built with a left and a right hand thread to make its length adjustable. When it is the correct length use the lock nut to prevent it from self adjusting.

Adjust the transmitter and/or servo extension arm so that it is possible to achieve a maximum rudder angle of 55 degrees each side of centre. Make a small ‘protractor’ that can be used to check this angle from plastic or card to simplify this task.

Another refinement you can add is a line between the servo/tiller connector and a strong point on the flange across the deck just ahead of the rudder. Adjust the length of this line so that it is impossible for the tiller arm on the rudder and servo/tiller connector to lock over (connector moving forward) rendering the rudder control impossible to recover. When adjusted correctly lock the line with cyano glue. Remember that cyano glues are not properly waterproof but they will work well for this task.

With the transmitter stick for the winch full in, add the drum in a position to give the close hauled sheeting position. Use the adjustable features of the winch, servo or transmitter to achieve the desired outward position and travel.

1.2.5 adding/removing the rudder

The tiller arm is tightened onto the rudder stock using an Allen key which is placed through an access hole in the transom (from inside the hull on the SWORD). To remove the rudder from the hull and keep the tiller arm in place you should add a 4 mm rod down through the upper rudder stock bearing in the deck as you remove the rudder. Lightly lock the tiller arm in place to retain the rod until you want to replace the rudder.

A little light oil or grease on the rudder stock helps to keep it free running.

When you are confident that you have the tiller arm on the rudder and the connection from the tiller arm to the servo adjusted correctly (so that it is capable of giving 55 degrees throw each side of the centreline) you should consider filing a flat on the upper end of the stock so that the tiller arm can lock on in only one position.

The advantage of this is that it is virtually impossible for the rudder to be knocked out of alignment in a collision and replacing the rudder after removal will give the same alignment each time.

The disadvantages are that it may be more difficult to use a riudder from another boat as a spare and , if the rudder is knocked in a collision, damage may occur to the servo or rudder instead.

To add the flat first measure accurately the angle that the tiller arm makes to the rudder. Remove the rudder from the boat and file a flat on the stock at the required angle.

1.2.6 sheet post

The height of the sheet post is adjustable. The grip it exerts in the trunking is controlled by the captive barrel nut on the lower end of the post. Tighten the barrel nut to squash the ‘O’ ring and it will be more difficult to move and also more difficult to replace inside the trunking. In strong winds it should be adjusted to grip tightly.

It is good practice to remove the sheet post between races and slacken the captive barrel nut to allow the ‘O’ ring to recover its shape.

1.2.7 keel fin

There are one or more transverse M2 screws through the top of the fin near the position of the keel bolt. They are there to align the fin correctly in the hull. Do not adjust or remove these screws. Take care, when removing the fin from the hull, that this screw does not damage the inside of the fin trunking.

NB Read the section titled 'care of moulded items - excess heat' before exposing the boat to excessive sunlight/heat.

1.2.8 keel bolt

Do not over tighten the keel bolt when securing the fin in place.

1.2.9 ballast

We have found that carriers are universally skilled at trashing our nicely finished and protected ballasts thus enabling you to receive them in a variety of misshapen forms with an interesting range of surface finishes. None of these enhances the boat performance, your pleasure at receiving the boat or our satisfaction with supplying it. So we have resolved to supply the ballast in spray finish only when a boat will be collected from our workshops or when we can personally deliver it. All other boats will be supplied with ballast taken as far as the prepared for spraying stage. You should anticipate lightly abrading the ballast and cleaning with alcohol/acetone before spraying. We recommend cellulose grey primer and find the acrylic substitutes rather poor. If the ballast become scratched after grounding it is fairly simple to fill, rub down and re-spray. If it is re-modelled or otherwise amended during carriage it will be easier for you to correct the damage and continue to the spraying stage.

It was SAILSetc practice to fit the bulb to the fin so that it is tilted upwards at the front by 2 to 2.5 degrees when the boat is floating on its design waterline – IOM, M and 10R only. This reduces the drag of the boat in the normal range of operating conditions. For very light airs you could reduce this to 1 degree and in strong winds you can increase it to 4 degrees. Use a squashed crimp between bulb and bottom of fin to chock the ballast to these angles.

The ballast of SWORD is designed so that its base sits on a plane at the maximum permitted draught but the major axis of the ballast is tilted upwards at the front by the required amount. It should not be varied except for experimenting in practice only.

1.2.10 mast rake

There may be a mark on the deck near the mast gate to indicate the rake of the mast. The system we use is: a line is scribed into the deck and, when the leading edge of the mast is aligned with it, the mast is vertical. 3 mm aft movement from that point gives 1 degree of mast rake. 12 mm gives 4 degrees. The exact angle is not important. The important thing is

that you can reproduce rake settings that you have used successfully before. You can note the mast rake on the sails themselves.

1.2.11 rigs

If you have bought completed rigs with the boat they will have been fitted to the boat and adjusted to their approximate trim.

Because it is not possible to simulate the real rigging loads that will occur in a real wind it is likely that some fittings (the attachment for the forestay, the swivel and for the sheet) on headsail booms (No 1 boom for IOM, M & 10R and all booms for A Class) will be placed in their approximate position **but not permanently fixed**. Before use they will need to be locked in place with some cyano glue – do this once you have rigged the boat and adjusted the rig tension in the appropriate wind strength and are happy with their positions.

Find the best fore and aft position for the headsail boom counterbalance weights by experimentation. Usually this is when the boom is nearly, but not fully, balanced.

If you bend the headsail boom counterbalance weight up to clear the deck - consider filing a small flat on the wire of the counterbalance weight so the lock screw can lock it to prevent the counterbalance weight from being knocked off alignment in a collision. This precaution may prevent the counterbalance weight fouling the deck.

1.2.12 adding/removing a rig

To add a rig you should do the following in order:

- place mast heel in mast tube and locate mast between mast gate in deck of boat
- check that the headsail leech line and forestay are not twisted
- attach headsail swivel to eye in deck
- attach backstay loop to hook on transom
- attach lower end of shrouds to deck (all rigs IOM, A Class; No 1 rigs for M and 10R)
- tighten shrouds and check that mast is vertical transversely – not needed when using snap in/out rigging screws
- add main and headsail sheets to booms
- adjust mast ‘ram’ to correct position for that rig
- tighten mainsail cunningham

Now you can fine tune rig as preferred for the prevailing conditions.

As a general guide:

Use evenly cambered sails up to the point where heel angle exceeds 30 degrees or if excess weather helm is experienced. When that happens the backstay should be tight enough to make the upper mainsail seam straight – the leech of the upper sail panel will just begin to

look slack. Sheet the headsail boom about 5-10 mm (10-20 mm for A Class) closer to the mast.

The terminations on the shrouds at top and bottom will settle down after use and the rigging screws will need to be tightened a little more to get the same tension. When they have settled down you should take the time to set each rig up, get the mast perfectly straight sideways with the desired shroud tension (do this by checking that the mainsail leech has the same amount of twist on each gybe), and then move the lock nuts down the rigging screw ends until they just meet the rigging screw bodies. The next time you rig the boat it will be much quicker to get the shroud tension and mast attitude correct.

To remove the rig carry out the same procedure in reverse order. If you do not slacken the backstay or forestay you will preserve the settings you have used for the next use of the rig.

1.2.13 understanding the use of the kicking strap and mast ram

The use of these two controls needs to be properly understood if you are going to tune your rig correctly.

kicking strap

The kicking strap should be used to control the amount of twist in the mainsail leech when the main boom is sheeted out fully. The mast ram and backstay crane will have no appreciable effect when the main boom is fully sheeted out. When you are tuning your rig before racing, make this adjustment first.

Be aware that when sailing downwind the boat will experience a lower apparent wind speed than the rig experiences when the boat is stationary (as you will be when tuning the rig). Therefore you will need to set more twist than seems reasonable. Check the twist with the boat sailing too.

mast ram

After setting the kicking strap sheet the main boom to the position you will use for close hauled sailing. The mainsail twist will probably not now be correct. Do not adjust the kicking strap or you will harm the setting you have just made. Instead use the mast ram in combination with the backstay and forestay tension to get the mainsail twist and luff curve that you need to achieve the overall twist and camber distribution. These alterations will not affect the down wind setting.

Be aware that the rig on the boat sailing to windward will experience a higher apparent wind speed than the rig experiences when the boat is stationary (as you will be when tuning the rig). Therefore you will need to set less twist than seems reasonable.

However it may be that where you tune your rig on the bank is higher than the rig will be on the water and the higher wind speed there will more than compensate for the extra apparent wind speed. Checking the sail twist with the boat sailing is the best way.

1.2.14 deck patches

Deck patches are normally supplied for you to fit when you are happy that you have understood the interior fit out of your boat. To add them we recommend the following procedure.

Add some soft liquid soap, the type than comes in handy dispensers for the washroom, to a little water. Add enough soap to the water to enable a film of water to remain without pulling back when it is applied to the deck flanges. Coat all the areas where the deck patch will stick and also the surrounding areas. Peel off the backing material and add the patch to the wetted area. The soapy water will allow you to move the patch around and stretch it out until it is where you want it. Drying time in the height of summer is less than an hour. Indoors in winter it may take several hours.

We use one of our screw top pots to keep the solution in so there is always some handy in the workshop.

Use the backing paper to make cardboard or plywood patterns for the patches. You will need to replace them one day.

The patch over the central part of the hull should be removed after each use of the boat to ventilate the rc equipment and hull properly. It may last for several days racing with care.

1.2.15 getting patches off

Carefully peel back a corner and, keeping it close down to the deck, pull the material firmly away from the deck. With care it should be possible to remove the adhesive film with the cloth. Sometimes this will not be possible and areas of adhesive will remain stuck to the boat. Generally it is best to avoid trying to use solvents to remove this adhesive as they will only spread the material more thinly over a larger area. They may damage the paint and boat too.

Instead use a small piece of deck patch material, perhaps some of the material you have pulled off, and stick its sticky side to the adhesive on the boat. Pull it off firmly. Keep doing this and you will find the adhesive is removed from the boat and picked up by the patch.

1.2.16 rig bags

Rig bags are designed for carrying and protecting the rigs during use at the race site. They are not designed for long term protection of the rigs which should be removed each time you return from racing. The sails will take a shape print from the bag and from other rigs in the bag thus spoiling their design shape.

A rig box will protect the rigs properly long term and is ideal for allowing the rigs to dry properly between use.

1.2.16 keel/rudder trailing edges

The trailing edge of our fins and rudders are designed to be about 0.5 mm thick and to be finished square. This feature is fundamental to the design and the trailing edges should not be sharpened in the hope that performance will be improved. Apart from reducing drag the thickness of the trailing edge serves to provide a solid and strong edge that is less likely to be damaged and less likely to damage you or anyone else handling the boat.

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2.2 IOM – notes specific to this class

2.2.1 internal ballast

When we measure an IOM we will add internal ballast as required to reach the rule minimum weight. We usually add about 20 grams inside the rc pot and the remainder each side of the fin box. This permits small adjustments to be made easily by changing the weight in the pot (for example if you replace your receiver with one of a different weight).

The ballast added each side of the fin box is wrapped in our self adhesive deck patch material and then bonded in with silicone sealant. It is possible to remove the ballast if required. The covering of deck patch material protects the sheet lead from corrosion and allows the sealant to bond properly.

From FRAKTAL No 20 onwards (October 2012) we amended the external ballast position a little and internal ballast will probably need to be just in front of the mast for correct trim.

2.2.2 basic rig tuning guide

The following rig settings are a starting point for sail/rig trim.

rig	heel angle	mast rake to vertical	gap main boom to centreline	camber in foot of mainsail	gap headsail boom	camber in foot of headsail
	degrees	degrees	mm	mm	mm	mm
1	0-10	2	10	20	55	20
1	10-30	1	10	25	55	30
1	30+	0	20	20	55	20
2	20-30	2	10	20	50	25
2	30+	2	20	20	50	20
3	20-30	4	20	20	50	20
3	30+	4	30	20	50	15

recently (2011) I have found these settings work well on sea/open water where there are largish waves – use with a good deal of twist in both headsail and mainsail.

1	0-10	1	15-20	30	70-75	40
1	10-30	1	20	30	75	30
1	30+	1	20	25	70	30
2	20-30	1.5	20	40	65	40

2	30+	1.5	20	40	65	40

2.2.3 removable ballast bulb

It should be unnecessary to remove the ballast between races. Check the fit of the ballast on the fin from time to time and tighten if necessary. The attitude of the ballast on the fin can be adjusted by using small packers at the leading or trailing edge of the fin inside the ballast slot.

end

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2.3 M – notes specific to this class

2.3.1 basic rig tuning guide

The following rig settings are a starting point for sail/rig trim.

rig	heel angle	mast rake to vertical	gap main boom to centreline	camber in foot of mainsail	gap headsail boom to mast	camber in foot of headsail
A swing	0-10	3	0	25	40	10
A swing	10-30	2	5	30	40	15
A swing	30+	1	15	25	40	10
A	0-10	3	10	25	55	20
A	10-30	2	10	30	55	30
A	30+	1	20	25	55	20
B1	20-30	2	10	25	60	25
B1	30+	2	20	25	60	20
C1	20-30	3	20	25	70	30
C1	30+	3	30	25	70	20
C2	20-30	4	20	25	70	30
C2	30+	4	35	25	70	20
C3	20-30	4	20	20	55	25
C3	30+	4	35	20	55	15

When sailing in waves expect to have the main 5 to 10 mm further out and use more camber in both sails.

2.3.2 removable ballast bulb

It should be unnecessary to remove the ballast between races. Check the fit of the ballast on the fin from time to time and tighten if necessary. The attitude of the ballast on the fin can be adjusted by using small packers at the leading or trailing edge of the fin inside the ballast slot.

2.3.3 mast vertical – conventional rigs

The mast of a conventional rig is vertical when the leading edge of the mast is 13 mm aft of the vertical face of the bulkhead.

Each 2 mm aft of that position is 1 degree of mast rake – therefore when the leading edge of the mast is 17 mm aft of the vertical face of the bulkhead, the mast rake is degrees aft.

2.3.4 mast vertical – swing rigs

The mast of a swing rig is vertical when the No 3 block is used with the hole forward of the centre position.

The four blocks can be used to give the following rake angles:

block	hole	rake
No 1	forward	+ 1.2 degrees – forward rake
No 2	forward	+ 0.6 degrees - forward rake
No 3	forward	0 degrees - vertical
No 4	central	-0.6 degrees – aft rake
No 3	aft	-1.2 degrees – aft rake
No 2	aft	-1.8 degrees – aft rake
No 1	aft	-2.4 degrees – aft rake

end

2.4 10R – notes specific to this class

2.4.1 basic rig tuning guide

The following rig settings are a starting point for sail/rig trim.

rig	heel angle	mast rake to vertical	gap main boom to centreline	camber in foot of mainsail	gap headsail boom to mast	camber in foot of headsail
1	0-10	3	15	25	65	25
1	10-30	2	15	30	65	35
1	30+	1	25	25	65	25
2	20-30	2	15	25	60	30
2	30+	2	25	25	60	25
3	20-30	3	20	25	60	25
3	30+	3	30	25	60	20
4	20-30	4	20	25	60	25
4	30+	4	30	25	60	20

When sailing in waves expect to have the main 5 to 10 mm further out and use more camber in both sails.

2.4.2 removable ballast bulb

It should be unnecessary to remove the ballast between races. Check the fit of the ballast on the fin from time to time and tighten if necessary. The attitude of the ballast on the fin can be adjusted by using small packers at the leading or trailing edge of the fin inside the ballast slot.

end

2.5 A – notes specific to this class

2.5.1 basic rig tuning guide

The following rig settings are a starting point for sail/rig trim.

rig	heel angle	mast rake to vertical	gap main boom to centreline	camber in foot of mainsail	gap headsail boom to mast	camber in foot of headsail
1	0-10	2	15	35	100	30
1	10-30	1	20	40	90	45
1	30+	0	35	25	80	30
2	20-30	1	20	35	90	40
2	30+	0	35	25	80	30
3	20-30	1	20	35	90	40
3	30+	0	35	25	80	30
4	20-30	1	35	35	90	35
4	30+	0	50	25	90	25

When sailing in waves expect to have the main 5 to 10 mm further out and use more camber in both sails.

2.5.2 removable ballast bulb

It is normal to remove the ballast from the fin for transport. It is a good idea to make a secure carrying box to protect it.

2.5.3 joining the mast

Because carriers have a remarkable ability to break even well packed masts during transit we have abandoned attempting to deliver masts in fully completed form. We will leave the join between the 16.5 mm and 14 mm diameter carbon tubes un-glued so the mast can be packed in a box less than 1.5 metres long or, if sent with a SWORD, inside the hull packaging box. The join is where the spreaders are located and the pre-drilled hole for the spreader connector wire is used as part of the locating method. The joint is pre-abraded and cleaned.

On arrival the mast should be joined as follows:

Take a length of 1.5 mm diameter stainless steel wire and coat it with wax polish and polish it with a dry cloth. Repeat the process. Mix 24 hour epoxy resin (if using a conventional epoxy

resin with 3:1 ratios mix at least 10 ml to ensure an accurate ratio) sufficient to coat the outside and the inside of the surfaces to be bonded. Push the tubes together using the piece of wire to locate the two in the correct relationship. Clean off any excess resin. Allow to cure. When cured use a pair of pliers to twist the wire to break the bond holding it in place. Extract it from the mast. Remove any alignment tapes.

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2.6 RG65 – notes specific to this class

2.6.1 basic rig tuning guide

The following rig settings are a starting point for sail/rig trim.

rig	heel angle	mast rake is fixed	gap main boom to centreline	camber in foot of mainsail	gap headsail boom to mast	camber in foot of headsail
A swing	0-10	-	0	10	20	5
A swing	10-30	-	3	15	20	10
A swing	30+	-	6	10	20	5
A	0-10	-	5	10	30	10
A	10-30	-	5	15	30	15
A	30+	-	10	10	30	10
B	20-30	-	5	15	30	15
B	30+	-	10	10	30	10
C	20-30	-	10	15	30	15
C	30+	-	15	10	30	10

When sailing in waves expect to have the main 3 to 5 mm further out and use more camber in both sails.

end

background information

the basic problem

The construction of a model yacht hull, its fin and rudder, is much like any other engineering problem. There are conflicting requirements, unwelcome constraints, and benefits which are difficult to evaluate. As usual the solutions are compromises.

requirements

A yacht rigged in the traditional way with forestay, shrouds and backstay has to be adequately stiff and strong (capable of withstanding the loads imposed by the rigging without deformation or failure of the overall hull structure).

- weight needs to be kept to a minimum in order to maximise the ballast weight for a given total displacement.
- strength (the ability to resist damage even when large deflections take place) is required to help a yacht to maintain its original appearance and value in the rough and tumble of competition without the need for constant maintenance.
- shape retention, even when the hull is loaded well above the normal static loads, e.g. when the yacht is planing hard, or when sailing to windward in large waves, keeps resistance to a minimum.
- surface finish of the foils needs to remain hydrodynamically smooth to maintain their performance at all speeds, and the surface finish of the hull needs to be smooth to maintain performance at low speeds.

constraints

Reinforcement materials available are rarely ideal for our purpose. Weaving a brittle material like carbon fibre is a slow and hence expensive process. Consequently most carbon cloths are relatively heavy to keep the cost per kilogram of carbon low. It is much more expensive to weave lighter carbon cloths which have more threads (tows) per square metre. However we know that using more layers of lighter cloths will usually give a stiffer and stronger laminate. This makes stiffer mouldings more costly to produce.

Additionally:

- The time taken to remove excess resin from a moulding can be quite high.

- Only a limited range of pigments for gel coats are compatible with epoxy resins and of these some are much less opaque than others.
- Generally the darker colour gel coats cover carbon reinforcement better but unfortunately it is these darker colours which reflect less light and hence heat up more when exposed to sunlight.
- The less opaque pigments that give poor coverage of carbon make it likely that carbon will show through the gel coat. Use of two gel coats to give a better colour adds weight, cost and makes the moulding more likely to crack.
- An ultra thin gel coat will permit the hull to flex under load considerably more before the gel coat fails.
- A thick gel coat will maintain a good surface finish for a longer period before the weave of the cloth 'prints' through. It will also give better protection against osmosis.

standard lay-up of hull - IOM

Generally we use one of our preferred gel coat colours applied to give a thin gel coat covering.

This is followed by two layers of reinforcement cloth wetted out with epoxy resin.

Excess cloth around the edges of the moulds is trimmed off and the two half hull mouldings are allowed to cure.

The two halves of the mould are bolted together and a joining strip, which also serves to reinforce the centreline, is added to the mouldings.

At all stages excess resin is removed to keep weight to a minimum.

standard lay-up of hull – M, 10R and A Class

These boats are made using pre-preg carbon with no coloured gel coat. The surface finish that can be achieved depends on the quality of the mould and this, in turn, depends on the materials and method of construction of the plug and mould. In all cases the weave of the black carbon shows through. The Marblehead hull surface is abraded to 400 grade and left matt finish. The 10R hull surface is not abraded and has a reasonably glossy finish out of the mould. The A Class hull is reasonably glossy with some areas that are abraded and re-polished.

standard lay-up of fin

We have conducted many trials to establish an optimum lay-up for the fins we produce. The requirements to produce a fin which will resist splitting when handled and to enable a sharp and strong trailing edge to be formed prevent us from using all high modulus material. The lay-up described is the best compromise at the moment.

gel coat	clear gel coat
first reinforcement	125 gram/m^2 plain weave carbon
second reinforcement	2 layers 300 gram/m^2 high modulus uni-directional carbon (1 layer is optimum for a One Metre fin)
third reinforcement	200 gram/m^2 plain weave carbon or bi-axial carbon

For the SWORD fin we use three reinforcement layers of 200-300 gram/m^2 plain weave carbon.

standard lay-up of fin box/mast tube moulding, deck moulding, other parts

The requirement here is basically for minimum weight mouldings. The complex shape of the fin box/mast tube and the deck moulding causes a special requirement for drapeability of the reinforcement materials.

gel coat	normally clear gel coat, coloured for the deck part
One Metre	layers of 300 gram/m^2 twill weave glass depending on item

crash damage

It hardly needs to be stated that radio yacht racing is a very competitive sport - that is probably why you are considering having a yacht built by SAILSetc. Inevitably mistakes of judgement occur which lead to collisions.

One Metre class

Hulls have been moulded using 2 x 165 gram/m^2 glass for many years and we have found this an excellent compromise between damage resistance and low weight. Finished boats typically have about 200-300 grams of internal ballast added (if using servo sized sail winch +

600 mAh metal hydride batteries) and 100-200 grams (if using RMG winch and 1100 mAh metal hydride batteries).

Marblehead and Ten Rater classes

In these classes most competitors are fully prepared to have yachts built as lightly as possible, commensurate with the other requirements, in order to gain a small speed advantage. Crash damage is a fact of life we accept in order to be more competitive. Others do not consider the sacrifice, in terms of durability and ease of maintenance, to be worth the extra speed. The choice remains yours.....

If resistance to crash damage is of prime importance to you then you should consider the following option:

- choose 2 x 200 gram/m2 carbon lay up instead of 200 + 120 gram/m2

as we have to order hulls in batches the choice may not always be available

A Class

The standard lay-up of 2 x 200 grams/m^2 with an additional layer for the hull bottom and the deck edge flanges seems an excellent compromise between weight and stiffness. The hulls are significantly lighter than the previous hand laminated versions and are much more resilient.

We will monitor long term performance of this lay-up and modify it if this proves useful.

care of moulded items - excess heat

The items made using pre-preg carbon (Marblehead, Ten Rater and A Class hulls from 2006 onwards) will be resistant to virtually all high temperatures likely to be encountered.

The following applies to all other items:

Epoxy resins offer significant advantages in strength, stiffness and adhesion to fibre reinforcements, over the more commonly used polyester resins. Like most resins they attain 90% of their ultimate strength relatively quickly but curing continues, dependent on temperature, for days, weeks and even months. Distortion is resisted by epoxy mouldings until the temperature exceeds the original curing temperature (normally 20 to 30 degrees C) when further curing takes place leading to minor distortion. Larger distortions will occur if the moulding is loaded when it is heated, for example, if the full weight of the yacht is being taken by the slings of a stand onto the hull rather than onto the keel.

Fins and rudders are particularly susceptible to heat distortion due to the air trapped inside. This expands when heated and will 'blow' the moulding if it is soft. To help prevent this, vent holes are drilled into the cavities at the top of the fin.

The fin is particularly likely to become heated to the point of softening because of its colour. This can happen very quickly if the yacht is left on its side in sunny weather, even if the air temperature is not high. The risk is higher in latitudes near the equator and when there is little breeze to cool the surface. If the ballast is poorly supported causing a twisting load on the fin at the same time the fin will twist out of shape. When the boat is launched the new 'twisted' shape will be frozen into the fin and performance will suffer.

The carbon rudders we have moulded recently have a section that does not permit 6 mm carbon tube to be used for the stock as the rudder thickness is less than this. We use 4 mm solid stainless steel for the stock. This means the cavity in the rudder is not vented and special care needs to be taken to keep the rudder from blowing.

The base of carbon fibre tube rudder stocks is left open so that the stock itself may act as a vent. Do not block these holes.

In our experience a large proportion of heat damage to our mouldings has occurred in the back of cars when, even on overcast days in the summer, sufficiently high temperatures can be reached. A thin white cloth laid over the hull in sunny weather gives good protection. Do not place thick blankets over the yacht.

The thinner and lighter weight mouldings will heat up and distort far quicker than heavier mouldings. Darker colours are affected more as they absorb ultra-violet light better. If the long term appearance of the surface finish is important to you, pay particular attention to keeping the hull cool.

Take the following precautions:

Preparation
- specify a lighter coloured gel coat
- spray the fin and rudder with grey primer or, even better, white primer

On hot or sunny days
- keep out of direct sun whenever possible
- avoid placing the hull on hot surfaces
- support the fin and ballast evenly when the boat is placed on its side
- remove the rig and place boat in a stand between races
- slacken rigging loads if there is a long time between races
- do not leave the boat in the car without adequate ventilation

care of moulded items - excess moisture

The very fine carbon and glass fibres absorb moisture very quickly if they are not protected by resin. Our hand laminated hulls have a very thin gel coat to keep weight to a minimum and this gives very little protection against moisture absorption. The inside of our mouldings are not given a further coat of resin (as are most mouldings intended for marine use) as this would have a serious detrimental effect on the stiffness/weight ratio. Indeed our reinforcement cloth usually has as much resin removed from it as is possible to lighten the lay up. This tends to create small air voids in the lay up which further increases the likelihood of moisture being trapped in the reinforcement cloth.

Cases of osmosis in our mouldings have occurred from time to time when storage conditions have been ideal for this to happen. It is of paramount importance that hulls are not left with water inside after sailing. Hulls should be stored between use in a dry condition and with the servo/winch patches removed to allow ventilation. Moisture will be trapped between the fin box and the fin (and the fin and the ballast) for some considerable time after sailing and will lead to osmosis on the matching surfaces. Where possible you should dismantle fin and ballast after use. Do not trap moist air in the yacht by covering with a cloth between use.

Take the following precautions:

At events
- avoid laying a hull on warm damp grass

Between events
- remove the centre deck patches to allow ventilation
- store hull in a dry condition
- do not leave damp cloths resting on the hull
- dismantle fin from fin box
- dismantle ballast from fin if possible

leaks

Unfortunately we can probably guarantee that our boats WILL take water on board when sailing. They are tested before leaving the workshop to see that the hull itself does not leak but there are several other areas where water gets in:

- winch sheet exit and return tubes
- rudder trunking – our rudder trunking with 'O' ring seal has eliminated this as a leak
- sheet post trunking – not a leak source if the post is locked properly

- small holes under deck patches especially at joins between the hull shell/deck
- possibly through the deck patch material itself – tests have not indicated that it leaks

All of these factors are accentuated when a warm boat is placed onto the water and the air inside it is quickly cooled thus creating a suction. This is especially true of the fin and rudder mouldings (remember the fin is vented to stop it from 'blowing up' in the sun).

The rudder trunking, 69d, that we incorporate into all our One Metre, M and 10R hulls has an 'O' ring seal to help prevent leakage.

The sheet post trunking has to have a small hole drilled near its lower end so that pressure created when the sheet post is pushed in does not force the sheet post back out of the trunking to foul the main boom.

The changes made in 2004 to the way the sheets are connected to the servo + drum controlled sheeting system mean that water ingress is reduced.

maintenance

clean after use to avoid corrosion

After sailing on salt water it is important to flush out the hull with fresh water.

For some time we built boats with an aluminium sheet post and trunking. These commonly suffer from corrosion and will lock up thus preventing adjustment. Make sure you avoid this by removing, cleaning and greasing the sheet post after sailing.

After 2004 the sheet post is acetal in an aluminium trunking. There may be some corrosion of the aluminium trunking but the two should not lock together. Maintain the function of the sheet post locking mechanism by removing the post, releasing the pressure on the 'O' ring and applying a little silicone grease.

After 2005 we eliminated all aluminium tubes in the construction of our boats in order to avoid metal corrosion.

Note the precautions to be taken to avoid osmosis.

Clean dirt and grime from the hull using soapy water, methylated spirits and/or acetone. The colour restoring polishes intended for cars are quite good at restoring the gloss where this has been scuffed.

restoring the surface finish of the hull

If the surface finish of a hull, fin or rudder develops the print of the backing reinforcement you can restore the original hydrodynamically smooth surface by rubbing down with 600

grade wet or dry abrasive paper. Use masking tape to delineate the waterline (there is little point expending energy on the topsides unless their appearance is critical) and use a small block of smooth wood or plastic to mount the abrasive paper on.

There is probably very little point in using a finer grade paper than 600 on the hull, but if you are keen, use 800, 1000 and 1200 grades in sequence on the forward 50% of the fin, hull and rudder in order of priority.

Expect to repeat this process if the cloth pattern shows through the gel coat. Do not apply any wax or other surface treatment in an attempt to reduce skin friction - the only ones that work are not permitted under RRS 53. The commonly available static friction reducing polishes only increase the likelihood that you will drop your yacht.

structural damage to the hull

Minor cracks in the gel coat where the hull structure behind is not seriously damaged are normally best ignored. More obvious cracks are normally associated with failure of the backing reinforcement. In these cases the material along the crack should be ground or filed out to allow the hull to return to its original shape at the earliest opportunity. This ensures the repair will not be so noticeable when it is made. Having done this you have two basic choices a) send the boat to us to repair and b) repair it yourself as below. In either case it may be as well to put tape over the hole and race until the end of the season when you can deal with all the damage at the same time.

rigging screw attachment points

Should the recesses under the keyhole plates for the rigging screws become filled with sand/soil you should remove one screw ONLY and slacken the other screw until the plate lifts and rotates clear of the recess. Remove the blocking material and replace the plate and tighten the screws.

replacement of headsail swivel

Take 600 mm of 50 kg Dyneema and pass one end down the tube through the foredeck until it emerges from the lower end. Pass the other end of the line down the tube so that it emerges from the hole on the other side of the transverse wire. It may help to tilt the hull to assist this process. Hold the lines together and tie an overhand know (half hitch) close to the bottom of the hull. Seal the knot with cyanoglue and trim off the excess on one side. Pass the end of the line up the tube, through a 52a fairlead which should be pushed into the top of the tube, and then tie a steel ring, item 46b, as close as possible to the deck. Seal the knot with cyanoglue and trim off the excess when it has cured.

Add self adhesive tape over the lower end of the foredeck tube.

replacement of bow bumper

Obtain the correct silicone sealant for this purpose. The only one we have found to work is a bathroom sealant which smells strongly of acetic acid (vinegar). Others (water based, smelling of peardrops, almonds etc) do not work. Use a sharp cutting knife to remove the existing bumper and as much of the adhesive as possible. Use abrasive paper to take off any

remaining adhesive from the hull. Clean the hull and the aft side of the replacement bow bumper with acetone or alcohol. Mask around the bow using adhesive tape. Apply sealant to the aft face of the bumper and the hull and press the two together. Use cotton buds to remove excess sealant without disturbing the bumper. Allow to cure for several hours. Remove the protective tape, and use solvent to remove the remaining sealant before it cures fully. Allow to fully cure before using.

Maintain as follows:

After sailing in salt water
- drain water from hull, wash out inside with fresh water
- wash outside of hull with fresh water
- remove the centre deck patches to vent the hull
- wash/spray all rigs and sails with fresh water

After sailing
- clean off any dirt with warm soapy water, methylated spirits, alcohol or acetone
- remove the centre deck patches to vent the hull

After damage
- cover minor cracks of the gel coat with tape
- cut away the fractured fibres of more obvious cracks and cover with tape
- repair damage at end of season

repairs

For minor cracks in the gel coat where the hull structure behind is not seriously damaged

The area inside the hull surrounding the damage should be abraded with coarse abrasive paper. Depending on the position and seriousness of the damage, use a patch of reinforcement wetted out with the minimum of epoxy resin to patch the hull inside. Overlap the damage by 20 mm in all directions.

When cured, and if it is large enough, the crack in the gel coat should be filled with resin pigmented to the correct colour. When this has cured mask off the surrounding area and carefully rub down the new gel coat with 600, 800, 1000 and 1200 abrasive papers. Finally buff it with metal polish to restore the original finish.

Small cracks may be left un-filled but can be abraded with 1000 and 1200 grade wet or dry abrasive papers. Finally buff it with metal polish to restore the original finish.

Where there are large chips of gel coat missing

If the reinforcement material behind the missing gel coat is fractured, proceed as for minor cracks (above) and add a patch of reinforcement behind the chip. Leave to cure.

Use the point of a sharp cutting tool to abrade the outer surface of the reinforcement material thoroughly so that the gel coat you will add may properly bond with the reinforcement surface. Clean the surface with solvent.

Fill the chip in the gel coat with resin pigmented to the correct colour. It may help to apply a small patch of Mylar film over the gel coat to create a smooth outer surface. When this has cured mask off the surrounding area and carefully rub down the new gel coat with 600, 800, 1000 and 1200 abrasive papers. Finally buff it with metal polish to restore the original finish.

For more serious damage where complete failure of the backing reinforcement has occurred

In these cases the material along the crack should be ground or filed out to allow the hull to return to its original shape at the earliest opportunity. This ensures the repair will not be so noticeable when it is made. The area inside the hull surrounding the damage should be abraded with coarse abrasive paper. Use self adhesive tape as necessary on the outside to hold the pieces of hull in their correct alignment.

Depending on the position and seriousness of the damage, use a patch of reinforcement wetted out with the minimum of epoxy resin to patch the hull inside. Overlap the damage by 20 mm in all directions. Avoid allowing resin to fill the crack.

When cured, fill the crack in the gel coat with resin pigmented to the correct colour. It may help to apply a small patch of mylar film over the gel coat to create a smooth outer surface. When this has cured mask off the surrounding area and carefully rub down the new gel coat with 600, 800, 1000 and 1200 abrasive papers. Finally buff it with metal polish to restore the original finish.

For blisters caused by osmosis

These should be pricked with a sharp point to allow the moisture to escape. Allow the moulding to dry thoroughly. If the blisters are on external surfaces and it is necessary to repair them, the loose gel coat should be broken out and thoroughly cleaned with solvent before each hole is filled with a spot of pigmented gel coat. When this has cured it should be rubbed down and polished as described above. If the blisters are on internal surfaces and pose no cosmetic problem they can be sealed with a spot of cyano-acrylate glue. Ensure all the glue has dried before re-assembling a fin treated like this into a fin box.

Damage to a hull caused by excessive heat

This can usually be restored, at least partly, by gently heating the whole hull to a temperature exceeding the temperature at which the damage occurred. This allows the whole hull to soften and return to its original shape. We can use a large low-temperature oven for this purpose but the technique of placing the hull in a car on a hot, sunny day has been used with success.

The same applies to a fin which has become twisted or bent. We heat the fin to around 60 degrees C and counter twist the fin until it is straight and then chill it under cold water. Sometimes we have to go to higher temperatures than this. The process tends to reduce the future risk of damage. Again, placing the fin in direct sun behind glass (dashboard of a car) is a possible substitute for an oven.

Materials

We can supply several items to assist with repairs. Take a look at the BOATBUILDING MATERIALS section of the website.

In house repairs

We are happy to provide a repair service at our normal workshop rates should you prefer us to tackle the problem.

to sum up

You need to be aware that there are a number of pitfalls into which you can fall and which will result in damage to your boat.

We can provide 'bullet proof' and 'indestructible' yachts if you are prepared to pay the price, both in financial and performance terms.

We can build incredibly light yachts which will perform somewhat less well in terms of damage resistance.

Unless otherwise instructed we will provide the standard lay up which is a compromise between the two extremes.

We do not offer any guarantees concerning the long term quality of the surface finish of our mouldings.

Even if your hull is seriously damaged, it can probably be repaired.

Even if your fin is seriously twisted, it can probably be restored.

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