SILHOUETTE **MAKE & MEND** Sheets

No.5 **BILGE KEELS**

Editor: Ian Rodger

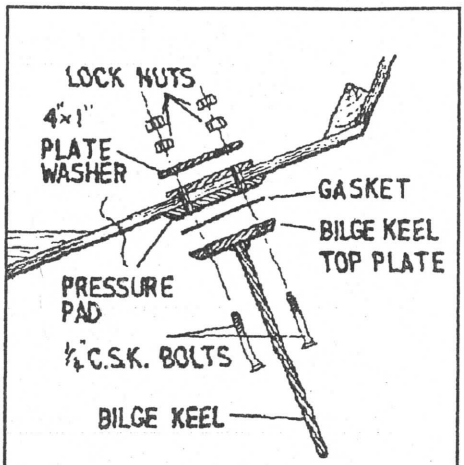
Bilge keels have featured regularly in the contents of the Silhouette Owner over the past thirty years. In the seventies there were ideas about extending them, adding extra weight, shifting their position forward and so on, in the quest for better performance and in the everlasting battle against weather helm.

Robert Tucker's article on the development of the twin and triple keel designs clearly indicates his thinking on their function, though at the time of writing (1963), the SIII had not yet been designed. While no one would pretend that these configurations have produced the perfect boat, the general advice to people wondering whether to modify the bilge keels on the MkII Silhouette is "DON'T"!

It is perhaps worth mentioning one mod. that is not reccommended, though it is proposed from time to time. This is the idea of extending the depth of the bilge keels, with added weight at the bottom, to increase the righting moment and make the boat stiffer. However, the boat is designed to ground on its ballast keel, with the hog plank taking the main weight of the boat. The bilge keel stringers are simply not strong enough to support the hull, and if you do decide to go ahead you must also extend the depth of the ballast keel so that all three finish level. The increased resistance of the added material may well outweigh any useful gain in speed or stability.

Most MkII's will have had some attention to their bilge keels by now. If a complete renewal is necessary, you can either make your own, get them fabricated locally, or buy sets ready made up from a steel fabrication engineer.

The articles on the following pages describe the procedures on both plywood and grp MkII's. Note that the GRP MkII keels are rather easier to fit since they bolt directly to a moulded flat face on the hull, whereas the ply hull requires a fairing piece to accommodate the twist of the bottom panel. If you have to remove these, do remember to mark them 'port' and 'starboard', 'front' and 'back', as they are not interchangeable. If you replace them in the wrong orientation the keels will not be parallel.



Silhouette Mk II
Bilge keel assembly

Some owners of the GRP boats have found it difficult to get at the ballast keel bolts which may be covered over with fibreglass. You just have to grind or dig them out and make good afterwards.

TESSA'S NEW BILGE KEELS

By Cyril Longson

When tapped with a hammer, the bilge keels of my GRP Silhouette II *Tessa* left more on the boatyard deck than was attached to the boat! Obviously something had to be done, and done quickly. The most difficult part was coming to a decision, how to set about the job. Many days were spent pondering the problem, but once the decision had been made, the rest seemed to fall into line. *Tessa* is of GRP construction, and the fixing nuts (fourteen to each plate) were fibreglassed over, and being a rank amateur, I sought the opinion of an expert, and who better than a former employee of George Hurley, who informed me that the nuts were best uncovered by using an electric grinder. Not having one - or the necessary cable, I decided a 1" wood chisel and mallet would do just as well. After cutting round the outline of the nut it was possible to remove the top, leaving it fully exposed. In less than an hour the work was completed. The next job was a little more time consuming, as I only had a small adjustable spanner, which is apt to spread when pressure is exerted on it. Eventually, all but two nuts were unscrewed, and a cold chisel was effectively used on them. One was still reluctant, and I was obliged to borrow a small open ended 5/8" spanner. This, with the assistance of a screwdriver wedged between the jaws of the spanner and the nut did the trick. But the keels were still firmly stuck to the hull, and a larger hammer was needed to knock out the bolts. First, a wedge was placed beneath the keels to give a firmer platform, and the bolts were hammered until level with the inside of the hull. A drift was then used to finish the job. When the last bolt was released the keel and wooden wedge between hull and keel simply fell away.

I had the new bilge keels made up by a local blacksmith in Plymouth. The materials used wereas follows:

3'6" x 2' 0" x 3/8" steel
7'0" x 4" x 3/8" flat iron bar
8 welding rods
4 hours labour.

He also had them galvanised ready for painting. Before applying marine paint, you should apply a coat of zinc chromate (yellow chromate) primer. I found the chromate quite thick, and consequently it took quite some time to dry properly. Mastic, such as is used for sealing

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gutters, is then applied 1/4" inside the edge of the flange and also around each keel bolt hole. The wooden spacing piece is then placed on top, making sure the holes correspond. The mastic is applied to the wood in the same manner.

Two 4" X 1/4" pilot bolts are inserted through the hull from inside at each end of the flange plates, and the keel is then offered up, the bolts threaded through each end, and nuts temporarily applied. The end of a length of timber approximately four foot long is then placed under the keel, and the other end is slowly lifted, levering the bilge keel against the hull, until the proper bolts can be inserted. The metric nuts were a tighter fit than the original 3/8" ones, and had to be screwed in. A little care should be taken, but once the bolt has been started, it is just a matter of perseverance. When the bolt is about half way through, check inside to see if it is possible to get the nut on. The whole operation is a lot easier if you have an assistant inside. Having fitted one end, repeat with another bolt at the other end of the keel, and then work along each side until all fourteen bolts are tightly nutted up The whole operation should take less than two hours. Where the 3/8" washers have been fibreglassed inside inside the hull, it will be necessary to ease the holes with a round file.

The excess mastic can be cleaned off with a knife, and then white spirit. Wedges can be placed under each keel to support its weight. After four days, the nuts should all be checked for tightness. I found that only four of the 24 nuts required less than a quarter turn at this stage.

Tessa has been in the water since June, and when hauled out this month (October), none of the bolts have shown any sign of leaks. This winter I intend to fibreglass them over. As I said, the new bolts are metric, and I decided for obvious reasons not to enlarge the 3/8" holes in the hull It is more exhausting this way, but gives a more satisfactory result. - No leaks!

The holes for the bolts were drilled larger than 3/8" to allow for the galvanising and the metric bolts that are now used. Don't forget the words of a rank amateur - the job always looks more difficult than it actually is.

BILGE KEELS for a PLYWOOD SII

by John Stables

When it came to making the new bilge-keels for my plywood SII, I was lucky in finding a local welding specialist who is also a qualified marine engineer. The only headache was the shape of the top-plates to which the fins are welded. These must be a good fit against the hull and though the designer provides a drawing showing the curve and angle of twist it is advisable to take the shape from the actual hull itself to allow for any error that may have occurred during the building.

After much head scratching the problem was resolved quite simply. The keel top-plate position was marked on the hull, giving parallel lines four inches apart, and softwood blocks were laid at each end of these lines and at right angles to them. The upper edges of these blocks were then planed until they were in line with each other when sighted from the stem or stern of the boat. A piece of wood of four inch by one inch section was next screwed to the tops of these blocks, and other pieces fitted between them and the hull at regular intervals. When removed from the hull the edges of the blocks thus gave the shape of the bilge-keel top-plates. Needless to say the completed keels must be a "pair," not identical, so that both port and starboard moulds are necessary.

The marine engineer soon bent the top-plates (bolt holes already drilled and edges radiused) to fit the moulds and then welded them to the flns. The holes for the bolts which hold the bilge-keels to the hull were easily made by standing the keels in place and drilling downwards through the top-plates. The keels rest on softwood pressure-pads, thus ensuring a tight fit when they are bolted in place.

Fitting the keels to the hull presented little difficulty. The hull was raised up on trestles to a convenient height (having first being turned over). Then the ballast keel was jacked up against the deadwood, the bolts being inserted from underneath with the nuts inside the hull. Before removing the jack it is essential to provide adequate support at both ends of the keel. The bilge-keels were easily held in place whilst a helper pushed the bolts home and then climbed inside the hull to screw on the nuts and locknuts.

During the bolting-on each of the three keels was bedded on a canvas gasket liberally coated with bedding compound on each side. The bolts and bolt holes were well luted with thick paint. The plate washers on the inside of the hull, two inches square for the ballast-keel bolts, and four inches by one inch for each pair of bilge-keel bolts, were also laid on bedding compound.

NEW KEELS for a GRP MkII

by Denis Heald

The first job is to remove the old keels. Jack up the boat either on its trailer or on blocks so that the centre keel is a few inches higher than the bilge keels and the boat can be careened so that the bilge keels can be removed In turn. I found it easler to do the removal and replacement of one side completely before tackling the other one.

The bilge keels are each held on by two rows of 3/8 x 3" countersunk bolts and nuts. The nuts and washers are accessible under the berths at each side and although the nuts will probably come off easlly the bolts will need a good drift and a lump hammer.

The keels on a flbreglass Sll are different from the wooden boat in that the top edge of the flange is straight, and the hull moulding is shaped to accommodate it. There is also a half inch thick wooden bed-

ding piece between the top flange and the grp moulding. When the old keel is removed the boat must be suitably supported so that you can climb in and out without fear that the boat will tip.

Take patterns of the keel plate and the top flange and take them to your local steel fabrication shop to have two of each profile cut. I pald £60 for them in 3/8" mild steel although the plans say 3/8, Hurleys used to flt 5/16 thick bilge keels, and that should be a little cheaper.

Before welding the top flange to the keel plate it is much easier to drill and countersink the flange before it is attached to the plate. Then the plate is welded to to the flange, tacked about every six inches and then deep penetration welded. If you cannot do this yourself you will have to enlist the help of your local welder. Take care that you identify the front and rear ends of the plates and the correct edge of the flange before welding. You can mark for drilling either by using the old keel flange or the hull itself and just to make sure, you can attach the flange to the hull as a dummy run before welding, then you know all the holes will line up when you fit the finished keel. New bolts and nuts will probably be required.

You may consider galvanising the new keel plates although I personally feel that the new keels will outlast the boat anyway.

When refitting you will need to bed the flanges on to the wooden bedding pieces (you may or may not need to renew these) with mastic between both joints, cleaning excess off after tightening evenly.

The total time taken for me to do to the whole job was three days including making the new keels, but excluding procurement time for the steel. Steel bilge keels can be obtained from:

Renshaw & Milner
New Forge Works
Main Steet, Claypole
Newark NG23 5BJ
Tel 01636 84234

Speak to Dave Milner who is an SOIA member.

Twins and Triplets

By Robert Tucker (written in 1963)

There is a common belief that the twin-keel concept sprung from the desire to produce a boat which would sit upright on the mud; this is quite untrue, although it is the only virtue which can be claimed for some twin keelers which have been built. The idea was in fact engendered by the bilge-board scows of the Great Lakes, which proved in 1904-5 that two retractable keels, set at quarter beam and angled to be vertical at the optimum sailing angle of the hull, were rather more efficient to windward than a single retractable centreboard. This can be demonstrated by simple hydrodynamics, and seen by the efforts necessarily made to keep racing dinghies upright when beating to windward.

The first experimental work on a small twin-keel cruiser therefore followed these lines, the idea being to use the bilgeboard cases as berth fronts. The result was berths too narrow for the normal body so the idea was eventually discarded in favour of fixed, non-retractable steel-plate keels fixed to the hull at quarter beam and set to give maximum windward efficiency at the normal sailing angles of 15 degrees heel and 14 degrees crab. The outcome was Silhouette I, 16ft. 6ins. overall, 12ft. 6ins. waterline, with 6 ft. beam, which went to windward as well as any comparable centreboard or keel cruisers on a designed draught of only 12ins. This was really a fantastic achievement by any standards, yet the odd thing is that it was, and ever has been, quite ignored. So, for that matter, has the fact that these tiny little cruisers, with most of their ballast inside, have proved themselves well able to make long open-water cruises safely, often indeed, in relatively inexperienced hands.

Thence the way branched into two main types—twins and triplets—basically differentiated in that twins have fully ballasted bilge keels with no central keel (MkIII Silhouette) while triplets have light bilge keels with moment of the heel on the centre (MkII).

Probably the two best known examples of pure twins are the Caprice and Mystic, the latter having been developed from the former. In the beginning the Caprice used keels of simple section, streamlined slightly at bow and stern, but these gave way to the asymmetric hydrofoil, developed from consideration of the aerofoil characteristics of wings and with the aid of a considerable programme of wind-tunnel and tank research. These keels are a tremendous design problem. If the solution is correct they are extremely efficient and can lead to zero leeway, but if it is wrong they offer no advantages at all. Even at their best, of course, they must lose efficiency when the wave height exceeds about 25% of the boat's length, and leeway must result and efficiency seems to fall once the lee keel passes beyond the vertical with increasing heel.

Unless some distortion of the hull form or rig is adopted, the normal cruiser must associate a large rudder skeg with the twins, to provide lateral resistance aft. Failure to balance in this way has led to the growing use of auxiliary centreboards aft, to reduce weather helm in difficult conditions, although this device has not yet proved necessary in our own types of yacht. The critical factors in skeg design are area, its position relative to the overall hull and its effect on the rudder. Whilst it is basically true that the centre of pressure of a foil surface moves towards the leading edge as the speed increases, lateral resistance (like drive from sails) is not purely an edge phenomenon; thus when a propellor aperture is cut out the area lost must be replaced or compensated.

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