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Ballast Castings

Use of SAILSetc ballast castings

SAILSETC
Technical Information
TI 23

General
Most of these notes deal with One Metre and Marblehead ballasts which are cast in machined aluminium moulds. Much of the information will apply to our 6 Metre and A Class ballast castings too. The section at the end headed **6M and A Ballasts** deals with the differences.

Earlier SAILSetc designs (1990 - 1998)
The shape is based on Young's designs for low drag solid bodies. They have been used with success for many years and, in the absence of better knowledge, remain a good choice of ballast shape.

Plan for ballast designs (2002)
A Marine Modelling plan, MAR3007, available from SAILSetc, shows shapes suitable for all classes of model yachts. Two ballasts are shown with a round cross section. One ballast is shown with a flattened cross section and a winged planform. This is more suitable for 6 Metre and A Class designs. All are based on a section shape by Eppler and suitable for the Reynolds numbers typical for rc yachts. Several scaled versions are shown and a method of scaling each to other sizes is shown. This permits patterns for ballasts in the range 1 to 22 kgs to be made.

Current SAILSetc designs for IOM, M & 10R
During the early part of 1998 a new ballast shape was designed for use on our One Metre designs. The shape was decided after looking at existing wind tunnel data and using it to minimise the frictional drag of the whole yacht at low speeds. The smaller diameter lowers the centre of gravity and this, along with the lower frictional drag, promotes performance at higher speeds too. We felt the new ballast was partly responsible for the success of the One Metre IKON and we were keen to use the same philosophy for the Marblehead ballast we supply. A new mould was made just in time to have a new ballast on the modified PARADOX 'RAD' which subsequently won the Marblehead World Championship in July 1998.

The Ten Rater ballast is a wide bodied version of the Marblehead ballast.

One Metre ballast, natural cast state, 2.4 kgs	Item 200-024
Marblehead ballast, natural cast state, 3.6 kgs	Item 200-036
Ten Rater ballast, natural cast state, 4.7 kgs	Item 200-047

See the catalogue for details of choices available.

The new designs are fully compatible with current SAILSetc fin mouldings - see Slot Size

Slot Size

One Metre	8 wide x 14 deep x 100 long
Marblehead/Ten Rater	8 wide x 18 deep x 100 long

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The slot is rectangular and is positioned at the longitudinal centre of gravity of the ballast. This accommodates our normal arrangement of fin and ballast which is designed to minimise fin twist and deflection. These slot sizes will accommodate most other fin sizes.

Casting
Each ballast has a 4 mm diameter brass rod running down its centre. This serves to strengthen and stiffen the fine ends of the ballast and protect them from damage. It also reinforces the ballast where it will be drilled to take the attachment bolt or studding in the middle of the slot. The restricted pouring hole size in the mould leads to occasional voids in the casting directly under the pouring hole. We aim to fill these with a lead shot and resin mix before supplying.

Replacement of an existing ballast
If the old ballast is ***readily removable*** in one piece the first step is to locate its longitudinal centre of gravity. Do this by making a noose in a piece of thick cord and using it to suspend the ballast. When you have found the balance point mark the position of the piece of cord. This is directly above the longitudinal centre of gravity.

If the old ballast is ***'permanently' fitted*** to the fin, take the precaution of drawing round the profile of the fin and ballast before removing the existing one. Use a new hacksaw blade and turpentine or turps substitute to lubricate when cutting. A bandsaw makes the job very quick and simple and it is worth finding someone who has one you can use. Cut the ballast off in as few chunks as possible and retain them. Re-assemble them into their original shape with adhesive tape and find their combined longitudinal centre of gravity using the method described above.

Now note the distance this longitudinal centre of gravity falls forward of, or behind, a near vertical line drawn on the fin.

When the new ballast is faired to shape and weight, repeat the test to find its longitudinal centre of gravity and arrange to fix the new ballast in the same position relative to the vertical line.

If the fin will not fit into the slot in the desired position you will need to enlarge the slot. If this seems likely you should allow for this when adjusting the total weight and, when this is done, re-check the longitudinal centre of gravity.

Trim to weight & fair
The natural cast state of the ballast castings leaves a grainy surface which can be smoothed initially with 100 grade grit if little weight is to be removed. Move on to 240 and finally 400 grade (use wet and dispose of waste into the dustbin rather than down the drain). Larger amounts of weight are best removed with a Surform. We use the convex blade held in the hand and drawn towards the body to cut the material rather than use the proper holding tool. Remove an amount all over in proportion to the local diameter. Then carry on abrading as above.

Maximising stability - minimising drag
Before bonding or casting the ballast onto the fin, pack any free space in the slot with lead and re-adjust the total weight and position of centre of gravity as needed. We add bronze powder to bonding resin to make it denser.

Alignment of ballast and fin
It may seem 'normal' to have the centreline of the ballast parallel to the waterline. Another way is to drop the aft end of the ballast by a few mm to arrange for the ballast to be aligned with the water flow when the hull trims down by the bow in normal sailing trim. We have found that 2 to 3 degrees of 'nose up' is best for all round performance. You may find that the mast needs moving aft, or raking aft, more than usual in order to restore balance.

Make a jig
It is well worth spending some time making a simple jig to hold the ballast and fin in the desired relative position so that they can be glued together with confidence that they will not be mis-aligned. It is usually quicker and cheaper to do the job properly once.

Permanently fixing the ballast
When you are confident you have positioned the centre of gravity and aligned the centreline of the ballast relative to the fin correctly you are ready to bond the two together. Abrade the bottom of the fin and mask off the part which will be above the slot with adhesive tape. Mix sufficient epoxy resin and thicken it with colloidal silica. Pour it into the slot and add the fin. Wipe off any excess resin and allow to cure. Fill any voids in the surface of the ballast with the excess resin.

Removable ballasts
Proceed as for a fixed ballast but carefully taper and smooth the lower end of the fin finishing with 600 grade abrasive. Give at least four coats of wax to the lower end before casting it into the ballast slot (same way as for a fixed ballast). Wait until the epoxy is well cured before attempting to remove the fin. Do this by holding the fin and ballast over a padded surface and 'knocking' the ballast off by striking vertically downwards with a block of timber in front of and behind the fin. Patience! Clean the wax off the fin with solvent.

Once the ballast is removed it is easy to move on to the painting stage after arranging the attachment details. A piece of 3 mm stainless steel studding is bonded into the bottom of the fin at the thickest point on the section. At least 50 mm should penetrate the fin and a nut should be positioned in a 'key hole' in the fin to help take the tension. Make the studding long enough to extend to within 2 or 3 mm of the base of the ballast. Bond the studding and nut in place with epoxy resin.

Now carefully mark out and drill the ballast to match the position of the studding. Enlarge the hole to 3.5 mm diameter. Counterbore the bottom of the ballast 6.5 mm diameter to a depth of only 10 mm to take a 'nut'. Make the nut from 6 mm diameter brass rod, 10 mm long, and make a slot across one end so a screwdriver can be used to tighten it. Take care not to over tighten the nut when attaching the ballast. The presence of the brass rod helps to take the load.

We can supply item INS-030 which comprises the studding, a special stainless steel insert (instead of a nut) which is bonded into the fin, and the special 'nut' that is used to retain the ballast.

Painting
Abrade the surface all over with 400 grade abrasive and wipe with methylated spirit or acetone to remove any grease. Suspend the ballast from the attachment hole (if it is a removable ballast) or place it on a piece of timber which fits into the slot. Paint using several coats of Hi Build (no longer sold by SAILSetc, sorry) or similar high solid content material. When cured rub down as for initial fairing taking care not to go through the paint. Alternatively spray with grey primer using six or so coats. Cellulose based sprays seem to cover better than acrylics. When dry rub down using 600 grade and 800 grade abrasives. We leave sprayed ballasts in primer finish as it is far easier to rub down to get a good finish and to add more to cover any scratches.

6M and A ballasts
The special shape of these demands the use of a harder alloy to avoid the thinner parts being easily damaged. The material is worked in much the same way as pure lead. The larger surface

area and sand casting technique means a rougher finish and greater weight variation than for the other ballasts.

Rather than bond these ballasts to a fin using a slot we rely on a piece of 6 mm stainless steel studding passing through a single vertical hole through the deepest section. The studding has a nut and washer (recessed into the ballast) on the lower end, passes vertically through the ballast, the fin and then through the deck. Another washer and nut serves to attach the ballast, fin and hull together. Two locating studs of 4 mm stainless steel rod, one fore and one aft, stop the ballast from twisting on the fin.