

Ballast Pattern - Bulb

For deep draught classes

Introduction

The ballast pattern provides a form from which a cast ballast may be made. The pattern is supplied in kit form and requires assembly before use. The geometries available are:

Target finished casting weight	0.6 kgs, 2.4 kgs, 3.3 kgs, or 4.0 kgs
Length/Diameter ratio:	8 :1 or 9.5:1
Width/depth ratio	1:1 or 1.2:1
Split	Port/starboard or Fore/aft

The pattern is 3D printed in eSun's "PLA Plus", a high temperature engineering filament with superior mechanical properties.

The port/starboard pattern has four components, two port and two starboard, each comprising a fore part and an aft part, as illustrated in Figure 1. The fore/aft pattern comprises two components, a fore part and an aft part, as illustrated in Figure 2.



Scope of the patterns

The range of geometries available cover most of the normal requirements for bulbs of this type. Heavier castings can be created, if required, by placing a spacer of an appropriate thickness

between the port and starboard halves of a port/starboard split pattern. Note there is no possibility of creating a heavier casting in this way using a fore/aft split pattern.

If the bulb you need cannot be produced from one of our standard geometry patterns, please ask, we may be able to help.

Preparation

Check the surfaces of the printed parts for any irregular upstanding roughness, and remove using 80 or 100 grade abrasive paper. PLA is best sanded wet and relatively slowly. Local heat build-up during sanding does not dissipate very quickly, softening the plastic and then clogging the sandpaper.

Check that the locating holes in the matching surfaces will easily accept the metal locating pin(s) supplied (12 mm length(s) of ¼" Ø aluminium alloy tube). Remove any obstructing fibres. Check the edges of the pin(s) and smooth away any burrs.

Assemble a port/starboard split pattern by following the steps of Section A, or the steps of Section B for a fore/aft split pattern. Epoxy is recommended for bonding PLA thermoplastic, as is any other specialist glue formulated for this application.

(A) Port/starboard split patterns

You need the following materials:

- Epoxy resin and thickener, or epoxy glue, and applicator stick/brush
- Flat surface large enough to lay the pattern parts onto while the glue sets
- Sheet of polythene or other plastic used to cover the flat surface to provide a non-stick layer
- Straight edge, pen
- Single or double-sided self-adhesive tape, rubber bands

Follow steps 1 to 5, and then 6 to 10 to make a pattern that allows a spacer of an appropriate thickness between the port and starboard halves. Follow steps 1 to 5, and then steps 11 to 16 to make a pattern whose halves are bonded together.

Bond port side parts together

The steps in this section bond the port parts of the ballast pattern together into the port half, with one fore part bonded to one aft part using the integral dovetail joint.

- (1) If the sheet of polythene or other plastic covering the flat surface is opaque, go to step 2. If the sheet is transparent, first draw a straight line down the centre of the flat surface 50 mm longer than the combined length of the pattern parts.
- (2) Place the plastic sheet on the flat surface. Fix the sheet to the surface with single or double sided self-adhesive tape. If the plastic sheet is transparent, ensure the straight line from step 1 is clearly visible. If not, draw the straight line described in step 1 onto the plastic sheet instead.
- (3) Trial fit together the fore and aft parts. Place them on the flat surface and use the straight line to align them correctly. Remove any excess material interfering with their fit.

(4) Mix sufficient epoxy resin or glue to bond the parts together. Apply the epoxy to each mating surface and then assemble the two parts on the plastic sheet aligned on the straight line. Press the two parts fully towards each other. Remove excess epoxy taking care not to disturb their alignment with the straight line. Check correct alignment afterwards.

Set a timer/alarm clock reminder to check the parts, after 1 hour at 20 °C, or after 2 hours at 15 °C. When the epoxy is partly cured it is easier to remove excess resin with solvent (acetone) and make a clean joint. Check and adjust the alignment as required. Allow to fully cure, preferably overnight.

(5) Remove the plastic sheet from the pattern. Abrade away any excess epoxy that adheres to the flat surface (the plane of symmetry) of the pattern half.

Follow steps 6 to 10 to make a pattern that allows a spacer of an appropriate thickness between the port and starboard halves. Follow steps 11 to 16 to make a pattern whose halves are bonded together.

Bond starboard parts together, keep separate from port half

The steps in this section bond the starboard half of the ballast pattern together, with one fore part bonded to one aft part using the integral dovetail joint. Note that the following assembly process uses the previously completed port half as an alignment guide. There is NO intention to bond the two halves together.

(6) Place the 4 locating pins into the holes in the port half of the pattern. Trial fit together the starboard parts by adding them to the port half. Remove any excess material interfering with their fit. Separate the starboard parts, ensuring that the 4 pins remain fully inserted in the port half.

(7) Cut a piece of the plastic sheet to match the outline of the flat surface of the port half, allowing 5-10 mm excess all round. Make small holes in the plastic sheet to coincide with the locating pins. Use double sided tape to attach the sheet to the port half, taking care to keep the tape away from the locating pins.

(8) Mix sufficient epoxy resin to bond the starboard parts together. Apply epoxy to each mating surface and then assemble the two starboard parts on the plastic sheet. Use rubber bands or tape to hold the starboard parts to the port half taking care to align them correctly.

(9) Remove excess resin/glue taking care not to disturb the alignment.

Set a timer/alarm clock reminder to check the parts after 1 hour at 20 °C, or after 2 hours at 15 °C. As before, part cured epoxy is easier to remove with solvent (acetone). Make a clean joint, checking and adjusting alignment and fit as required. Allow to fully cure, preferably overnight.

(10) Separate the two halves of the pattern. Take care if there is resistance caused by leakage of the epoxy through the holes made in the plastic sheet to accommodate the locating pins. Abrade away any excess epoxy that adheres to the flat surface (the plane of symmetry) of the pattern half. **Proceed to the finishing stage, step 20.**

Bond starboard parts to port half

The following steps bond the starboard fore part to the starboard aft part using the integral dovetail joint, and bond these parts to the previously completed port half. Note that the following assembly process uses the port half as an alignment guide.

- (11) Place the 4 locating pins into the holes in the port half of the pattern. Trial fit together the starboard parts by adding them to the port half. Remove any excess material interfering with their fit. Separate the starboard parts.
- (12) Mix sufficient epoxy resin to bond the parts together. Apply epoxy to all mating surfaces and assemble the two starboard parts onto the port half. Use rubber bands or tape to hold the parts together taking care to align them correctly.
- (13) Remove excess resin/glue taking care not to disturb the alignment.
- (14) Set a timer/alarm clock reminder to check the parts after 1 hour at 20 °C, or after 2 hours at 15 °C. As before, part cured epoxy is easier to remove with solvent (acetone). Make a clean joint, checking and adjusting alignment and fit as required. Allow to fully cure, preferably overnight.
- (15) Abrade away any excess epoxy. **Proceed to the finishing stage, step 20.**

(B) Fore/aft split patterns

You need the following materials:

- Epoxy resin and thickener, or epoxy glue, and applicator stick/brush
- Self-adhesive tape

The fore part is bonded to the aft part using the locating pin to align the parts.

- (16) Trial fit together the fore and aft parts by placing the locating pin into the holes provided. Remove any excess material interfering with their fit.
- (17) Mix sufficient epoxy resin to bond the parts together. Apply epoxy to each mating surface and then assemble the two parts. Press the two parts fully towards each other. Remove excess resin/glue taking care not to disturb alignment and fit. Use small tabs of self-adhesive tape to maintain the correct relationship between the parts.
- (18) Stand the assembled parts somewhere safe where excess epoxy can drip without causing a problem.

Set a timer/alarm clock reminder to check the parts after 1 hour at 20 degrees C, or after 2 hours at 15 degrees C). When the epoxy is part cured it is easier to remove excess with solvent (acetone) and make a clean joint. Check and adjust the alignment as required. Allow to fully cure, preferably overnight.
- (19) Remove the self-adhesive tapes from the pattern. Abrade away any excess resin/glue that adheres to the surface of the pattern. Proceed to the finishing stage, step 20.

Finishing the pattern

(20) The pattern is intended for use with the sand casting process. The surface finish will probably be perfectly satisfactory to use as it is but it will be slightly easier for the foundry to use the pattern if you prepare a super smooth surface as follows.

You need the following materials:

- Primer spray paint
- Polyester filler
- Double-sided tape for a pattern with separate halves and optional spacer

A pattern with separate port and starboard halves requires the two halves to be held together during finishing, including any spacer required. A low-tack double-sided tape is recommended.

(21) Wrap 180 grade grit paper around a hard block of plastic, wood, or metal. Abrade the pattern surface all over, using water as a lubricant and coolant. Aim to make the surface fair, removing any major irregularities - it is not necessary to achieve a homogenous finish all over. Allow to dry.

(22) Spray the pattern all over using a primer spray paint (*). Hang the pattern for a better covering rather than spraying it on a flat surface. Allow to dry.

(*). Check that the intended primer is suited to PLA thermoplastic, the pattern may need degreasing first with isopropyl alcohol (IPA).

(23) The primed surface will reveal any hollows/blemishes making it easy to fill them using a polyester paste. Mix the polyester filler and apply to the hollows. Avoid over filling – several applications will be needed anyway and it will be easier to abrade each time if too little rather than too much is applied. Allow to cure.

(24) Wet abrade using 180 grade grit paper all over. Allow to dry.

(25) Repeat steps 23 & 24, and possibly step 22, until you have a blemish free surface.

(26) Wet abrade using 400 grade grit paper, dry, and give a final coat of primer spray as per step 22.

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