A Marine *and* Safety Tasmania Guide to Buoyancy in Trailer Boats

Introduction

The MAST Recreational Boating Safety Review, conducted in 2000, indicated that nearly 50% of all boating incidents involved vessels capsizing or being swamped. This obviously results in the occupants ending up in the water where there is a risk of hypothermia. In July 2006, the NMSC's Australian Builders Plate (ABP) was introduced requiring manufacturers of new vessels to provide buoyancy in all their vessels under 6 metres. This ABP is also required to indicate whether the boat would have basic flotation or whether it would float level, known as positive buoyancy.

But those people who are boating in older boats (those that were constructed prior to July 2006) do not necessarily know whether their boat will stay afloat in such an incident.

This report highlights the reasons why buoyancy is so important, how to calculate the required buoyancy in a vessel and also provides detailed information on the types of buoyancy that can be used and how it can be easily fitted to existing boats.

Why vessels require buoyancy?

Do you think your boat would float if it was swamped or capsized? If it did float would it float in a level position? These are the questions that all boat owners should ask themselves. If this does happen to your boat, the chances of survival are greatly increased if it does float level. It gives those on board time to reach life-saving equipment, and in some cases, even attempt to bail the water out. Even if the boat floats where the deck is level with the sea surface, it allows occupants to stay with the boat and even get back into it. Being able to stay with a floating vessel increases the chance of survival as the boat provides a much larger search target than a human does for search and rescue authorities to locate and it may give the occupants the opportunity to get out of the water thus limiting the effects of hypothermia.

How much buoyancy do you require?

Most trailer boats have some form of buoyancy. This may be void air compartments which are common under the floor in nearly all fibreglass boats, or it may consist of foam. But how do we know that this existing buoyancy is sufficient to float the boat, its machinery/motor and its occupants?

The following formulae provide a simple way to calculate this, providing you know the weight of the boats and its machinery/motor and the density of buoyancy material. Obviously a different formula is used for timber vessels as in this case the structural material (timber) floats.

Aluminium, GRP and Steel	**Timber**
$\frac{1.2 \times (M \times K + F)}{1000-D}$	$\frac{1.2 \times F}{1000-D}$

M = Hull and Deck Mass
K = Alum 0.62, GRP 0.375, Steel 0.87
F = Mass of machinery and fittings
D = Density of buoyancy material (foam approx 35kg/cubic metre)

Example for an aluminium vessel

$$\frac{1.2 \times (425 \times 0.62 + 135)}{1000 - 35}$$

= *0.496 cubic metres*

where: M = 425kg (hull and deck mass)
K = Alum 0.62
F = 135kg (machinery/motor)
D = 35kg/cubic metre

In order to determine how much additional buoyancy is required, firstly you need to determine how much buoyancy you currently have. In the case of aluminium boats with foam buoyancy, you need to measure the dimensions of the individual pieces of foam and multiply the length x width x height.

Example: A piece of foam measuring 750mm x 400mm x 350mm
= 0.75 x 0.40 x 0.35
= 0.105 cubic metres

For those people with fibreglass boats and underfloor air voids, determining the amount of current buoyancy is more difficult. It is hard to determine the shape and size of the void space and you also do not know how much of this space is attributed to floor stringers and other structure.

One way of calculating this space with some accuracy is to position the boat and trailer on a slight incline (bow down) and fill the void space with water. Ensure that the trapped air in this space is able to vent while the space is being filled. Bear in mind that it is difficult to fill this space completely with water but you should get it 80-90% full. Once you have done this you can screw the bung back into place, turn the boat around so it is now facing with the stern down the incline and measure how much water runs out. This can be done in buckets. The average household bucket is around 9.6 litres.

1000 litres of water equates to 1.00 cubic metres so if you measure 200 litres of water from under your floor this is equal to 0.2 cubic metres.

Types of buoyancy

As stated, there are two common methods for flotation. Void air compartments are common however these compartments can fill with water if there is a leak. Consequently, if your boat has been swamped, or if the vessel gets holed, these compartments are slowly filling with water and your boat is slowly sinking below you. Some more modern boats separate this space into compartments so that the entire space cannot fill water in this situation.

Closed-cell foam is the more advisable method for buoyancy. As the name suggests the foam is closed-cell meaning that water cannot transfer from one cell to another and soak up water like a sponge. This foam can be cut into any shape to fit into areas of your boat.

The most common type of foam is polystyrene. This is white in colour and similar to packaging material. This foam can soak up water and, most importantly, it is not impervious to petro-chemicals, which includes petrol and some glues. If you ever have a fuel leak near this type of buoyancy, the foam will melt.

If you are contemplating adding additional buoyancy then polyurethane or polyethylene foam is better as it will not soak up any water and is not affected by petrol and chemicals.

Polyethylene foams such as *Microlen™* and *Thermotec™* are easier to work with than polyurethane as they do not crumble. Depending on the sheet thickness it can also bent into curved places and it can also be compressed into place, whereas polyurethane is rigid.

Polyurethane sheet foam can wear away with abrasion so it must be wrapped in plastic before fitting. Polyurethane is also available as liquid pouring foam.

Polyurethane pouring (expanding) foam

Microlen polyethylene foam

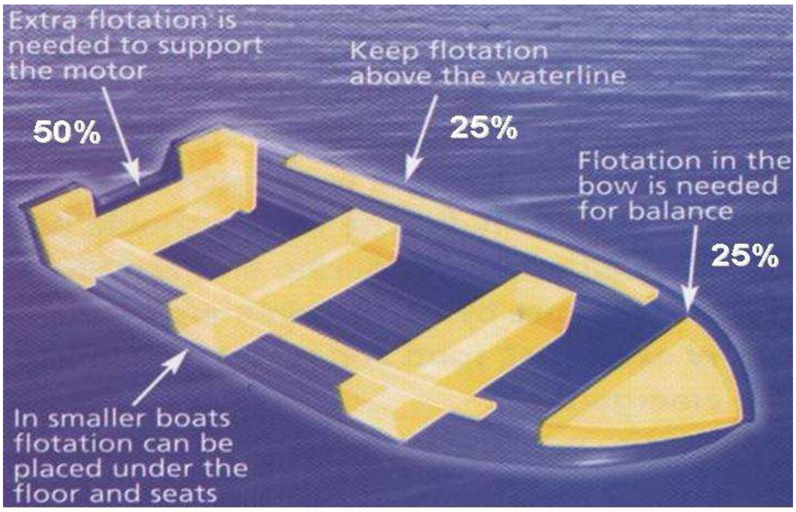
Polyurethane sheet foam

Distribution and placement of additional buoyancy

Unless you own an open dinghy with buoyancy under the seats, it is likely that your current buoyancy will be air or foam located under the floor. Any additional buoyancy should be distributed in such a way as to allow the boat to float level if swamped and it also should be placed as high as possible.

A guide is to get 50% of the buoyancy in the aft 30% of the hull, 25% should be in the passenger carrying area, and as high as possible, such as under the gunwales and the remaining 25% should be placed in the front of the passenger carrying area. Many boaters are concerned that additional buoyancy may reduce storage space and more importantly useable cockpit space within the boat however an adequate amount can be added without this occurring.

If the entire vessel buoyancy is under the floor and the vessel becomes swamped, it will capsize and end up in an upside-down position.



How do I install additional buoyancy?

Additional buoyancy can be added to an existing boat relatively easily and cheaply and can be done by the boat owner. MAST recently added buoyancy to three average fibreglass runabouts and in each case added approximately one-third to half of the total required buoyancy without affecting storage or reducing space in the boat.

Above: The fibreglass runabouts that were part of the MAST trial to add buoyancy

Foam buoyancy can be cut, shaped and installed very easily using traditional wood-working techniques. The sheet foam can be marked with a felt-tipped pen and can be easily cut with a panel saw. A jigsaw is more useful for sheet thicknesses of 50mm and less.

Foam is easily marked with a felt-tipped pen

Foam is easily cut with a panel saw

A jigsaw is more effective on thinner sheets

Under-gunwale buoyancy

When installing foam under the gunwale of a vessel it is common to have to allow for the steering and engine controls and provide the ability to access and service these in the future. Consequently you will need to shape the foam to fit around these controls or only partly fill this space.

If partly filling this space only then the foam will need to glued in. *Sikaflex* or a similar solastic compound is ideal. If you have shaped your foam to fit around your controls then your buoyancy will need to be removable. The best way to do this is to use polyethylene. This type of foam has some "give" or compression in it so it can be cut slightly oversized and then "squashed" into place. It will be held in place with friction and sometimes by frames under the deck. If this is insufficient then very small "dobs" of Silastic, that can be broken away later if required, should be used.

You could also place a loose fitting conduit over your controls before installing your foam so that controls can be "moused" through the conduit in the future.

A 100mm thick piece of Microlen™ polyethylene foam about to be installed. Note the void that has been cut out to fit around the steering. This was shaped with a hacksaw blade.

A significant amount of buoyancy can be fitted under the gunwale. Here a 100mm and 50mm sheet has been installed side by side under compression.The buoyancy is also supported by a frame/rod holder which is just out of view. No adhesive was required.

Adding buoyancy in the stern

Most boats have an amount of space available in the stern. This is an ideal area for additional buoyancy as it will counteract the weight of machinery. Outboard pods can be foam-filled or built to be air-tight and vessels with conventional transoms with outboard wells can also accommodate additional buoyancy. The best way to achieve this by using sheet foam and gluing it to the inside of the transom, up under the deck or on the inside face of the topsides of the boat. Usually a significant amount of buoyancy can be added while still providing adequate room for batteries and fuel tanks.

Foam can be fitted under the outboard well and deck mould

Foam being fitted under the outboard well with Sikaflex

Polyurethane pouring foam

Polyurethane pouring foam is very useful for oddly-shaped voids that are hard to fill with sheet foam. Areas in the floor between frames and other sealed tanks can also be filled with foam. Make sure you check the expansion rate with the manufacturer or supplier to avoid overfilling as it can be difficult to contain and clean. Should you spill the liquid mix or overfill a space it is best to wait until it has completely expanded and dried then cut it away with a hacksaw bland or knife.

There are some contractors available who can spray this type of foam into areas of your boat. This is most effective for underfloor areas.

Make sure that you use protective eyewear and gloves when handling this product.

A 50/50 mix is measured and poured

Liquid is mixed together thoroughly

A small amount of liquid expands significantly

Costs

It is relatively inexpensive to add additional buoyancy to your boat. The runabouts used in this trial required approximately 0.40 -0.50 cubic metres of buoyancy. This trial contributed to between 33-50% of this required amount.

One sheet of polyethylene foam, measuring 2.40m x 1.20m, 100mm thick provides 0.288 cubic metres, which is slightly more than was needed. The cost of this sheet of foam was approximately $250 to buy, plus consumables such as adhesive.

Polyurethane pouring foam is around $40.00 for 2 litres. Check with the manufacturer to determine how much of this you will need.

These foams are available from:

The Fibreglass Shop, Hobart	Phone: 62342689	
Foamland Hobart	Phone: 6231 2087	
Tamar Marine, Launceston	Phone: 6331 6188	
Foamland Launceston	Phone: 6326 6400	
Aquamarine (Aust) Pty Ltd	Phone: 0422 331 090.	www.marine.net.au
RMAX:	Phone: 6344 5644	www.rmax.com.au
P.J. Bowers Pty Ltd	Phone: (07) 5593 8277	www.pjbowers.com.au

Also check with your local fibreglass stockist for supply of foam.

If you sell these products, or know of other suppliers, please email peter.hopkins@mast.tas.gov.au and have them added to this website.

Summary

As you can see, adding additional foam to an existing boat is an inexpensive and relatively easy job with substantial benefits to the safety of the occupants in an emergency. All boat owners should do the calculation to determine how much buoyancy they need. Should they find that they currently do not have this required amount then there is no reason why they should not complete this exercise.

The following quick checklist will aid your planning:

1	***Do I need extra buoyancy?***	Calculate the existing amount in the boat.
2	***Why do I need it?***	To ensure the boat will float level if swamped
3	***Where will I put it?***	Under the gunwales and in the stern.
4	***What type will I use?***	Polyethylene or polyurethane sheet or pouring foam
5	***How will I fasten it?***	Compress it into place or bond it with Sikaflex
6	***What tools will I need?***	Jigsaw, panel saw, hacksaw blade, tape measure, felt-tipped pen, *Sikaflex*
7	***How much will it cost?***	Around $200-$300 for the average trailer boat

If you are unsure of retro fitting your own boat you should seek the services of a suitably qualified boat builder.

If you have any further queries regarding buoyancy in trailer boats then contact Peter Hopkins on 6235 8911 or email peter.hopkins@mast.tas.gov.au.