# Payload Construction

It’s not enough to simply hang a tracker from a balloon and parachute - you need to protect the tracker from physical harm, and (very very important) you need to protect whatever it lands on too!

Generally, flights land at a vertical speed of about 10mph, but this can roughly double if the remains of the balloon wrap themselves around the parachute. We try to avoid this but it does sometimes happen, with up to two thirds of the balloon remaining attached if it’s not a clean burst. Double the speed means 4 times the impact energy.

Soft, lightweight materials protect both the contents of the payload and whatever it lands on. Polystyrene foam is the material of choice, and it comes in two general types - extruded (stiff sheets) or expanded (softer but messy when cut). The latter also comes in preformed shapes such as boxes and hollow balls or eggs.

Polystyrene foam is also a very good thermal insulator, keeping the inside of the payload warm even when the outside is as cold as -60C. Remember though that the Pi in particular creates a fair amount of heat, and heat loss via convection is very low at high altitudes, so very little thermal insulation is actually needed especially if you have other heat generating devices (e.g. video cameras). Perhaps surprisingly, overheating is a greater risk. You do *not* need to add hand-warmers!

If you’re making a payload from sheets, you will need glue. Few glues work on polystyrene foam, and your best options are UHU Por which is specially designed for the task, or hot melt glue. The latter can be too hot so either use a low setting on the gun (if it has one) or don’t leave it to heat up for more than a few minutes.

When you are designing the layout of components inside the payload container, remember that some items (e.g. PITS) have connectors on them, and you have to leave space not only for the connected cables to fit, but possibly also for them to be able to be fitted after the Pi/PITS have been fixed down. Remember that batteries will be connected last, so make sure that the battery cable can be added last. Also, allow for access to the Pi micro SD card in case you need to change it or edit the configuration.

Make sure that anything inside the payload cannot move during flight. The burst and landing are both violent affairs. If your payload can’t survive a fall down stairs, then it’s not going to survive a flight either. Don’t be afraid to glue the Pi down with hot-melt. Use glue / double-sided stickers / lumps of foam to secure everything.

The payload will need some support lines so it can be attached to the parachute. For a box shape there should be 4 lines, one to each corner. These can be taped on outside (ugly, and potentially could come loose) or inside (neater and safer, but needs more thought).

The GPS aerial is placed outside normally, but should definitely be placed with a clear view of the sky above and to the horizon.

The radio aerial should be placed on the bottom, pointing vertically down. If there are 2 aerials then they should be 164mm apart. Remember to add a ground plane or wires to simulate a ground plane, and this can be common to both aerials if there are two.