

Foamcore Payload Construction

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Note to 2nd Ed: The 1st Ed of this paper was published in Proceedings of the First National Small Balloon Symposium, EOSS, 06/1993. This 2nd Edition has been converted to a Word97 file, Fig. 1 has been embedded, sketches illustrating miter joints added, and some material has been updated.

ABSTRACT: Foamcore sheet is a versatile and inexpensive material for use in fabricating custom balloon payload enclosures. Salient properties, design and construction techniques and flight experience are described.

Life for a high-altitude balloon electronics package can be rough. electronic goodies and batteries, and its skin is perforated with connectors and antenna feedlines and emblazoned with ham graffiti. Unnecessary appendages are chopped away to save weight. It flops around a workbench for weeks while its guts are tweaked and twisted with accelerating fervor as launch day approaches.

it gets a few more pokes and jabs for good measure before being bound and strung up like a horse thief.

faces even more grueling insults. As it ascends at over 10 mph, rushing air tugs at its supports, and wind shear tosses and twists it like a small boat on high seas. Its internal gasses belch forth as it rises

North Pole seem like a tropical beach party. Rising into the stratosphere provides a welcome respite, as the nearly non-existent air becomes calm, and everything warms up in the intense, unfiltered sunlight blazing forth from the black sky.

Just as life seems to getting a bit cozy, the support lines suddenly go limp, and our package finds itself plummeting helter-skelter down into the sky below. Whatever vestige of warmth may have penetrated its skin is ripped away by 200 mph winds, and the frigid tropopausal air forces its way into every crack, chilling its viscera to the core. After surviving another roller-coaster ride through the jet stream,

parachute will keep on plugging, bouncing its dazed passenger across whatever the surface may be until something strong and stationary snatches the package and wins the tug of war.

After what seems like an eternity in an even more desolate site, a swarm of fiercely-armed T-hunters converge on our voyager, attracted by plaintive cries for help driven by dying batteries though an antenna which may be buried up to its feedpoint. After a primitive ritual, the victorious captors load their quarry once again into a vehicle, this time with much less ceremony, for a considerably longer jostle back to its spawning grounds.

The next day, its creators commence their poking and jabbing again, scratching their heads in search of an explanation of how such a hastily crafted package could have survived its ordeal without dumping its contents all over the recovery site or even showing even moderate signs of wear.

PACKAGE REQUIREMENTS:

The foregoing story is fiction, of course, but it attempts to give the reader a feel for the environmental rigors which a high-altitude balloon payload should be prepared to endure. A well-designed and built payload package will reliably protect its contents from the environment without adding excessive weight.

If the package fails, then so will its contents in which you and your balloon group have invested so much time and money. Mechanical package failure can leave priceless goodies strewn along the flight path, or more likely, electrical connections may be damaged during landing shock thus shutting down the tracking beacon so important to the recovery task. Thermal failure can cause onboard electronics to malfunction from a combination of low temperatures and condensed moisture.

Design of a strong, well-insulated package becomes non-trivial when the burden of minimized weight is tacked on. Helium and balloon costs rise exponentially with payload weight, and once the several FAA weight limits are passed, flight clearances and logistics are complicated.

PACKAGING MATERIALS:

Edge of Space Sciences (EOSS) has flown packages made from molded styrofoam packaging material, built-up insulation-grade styrofoam sheet, bulk closed-cell polyethylene foam and foamcore sheet.

Although low density styrofoam exhibits excellent thermal insulation properties, it is difficult to cut even close to the right size and shape to fit the intended contents.

Bulk polyethylene foam is even rarer, being used primarily as packaging buffers for heavy, high-cost products. Being more rigid, it can be formed somewhat more easily than styrofoam and exhibits excellent shock resistance. Airtight seams and fine details are impractical to form, however, and

Foamcore is readily available in large sheets. It cuts and forms easily with sheet-metal precision, bonds with practically all adhesives, is exceptionally strong in shear stress, resists puncture, is very lightweight and offers moderate thermal insulation. Precision details, such as pc board mounting slots,

FLIGHT EXPERIENCE:

shaped package form was designed to protect the mirror from landing impact while housing the



SURFACE AND MOISTURE TREATMENTS:

The posterboard surface tolerates moderate amounts of water without damage. Moisture resistance can be improved with a light coat of acrylic spray paint, however. Loud orange provides a highly visible

or package closures in lieu of Kapton tape.

Interior condensation during descent through a cloud may be averted by including a desiccant-filled

cap is glued with RTV into a matching hole in the package wall, and the bottle is filled with 1 oz of dry silica gel desiccant before the flight. This 2 oz of prevention may be dispensed with if your weather forecast is clear. Desiccant packs found in the packaging for consumer products may provide some lighter-weight protection.

A brightly-colored plastic newspaper sack can provide both moisture and abrasion protection for

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A freshly glued joint cools slowly on this material, providing a few seconds of free time for alignment. overnight adhesive cures. The high-temperature variety of hot-

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Remember, the first pass should only cut the upper layer. A dead end cut may be terminated precisely with a near-vertical poke of the blade.

Keeping the straightedge in place, make the second pass like the first, except this time, cut through the foam and slightly into the surface of the bottom paper layer. This pass establishes the angle of the cut edge. If you want a simple square cut, then be careful to hold the blade perpendicular to the foamcore surface through this pass. Square up any dead ends with vertical pokes completely through the lower paper.

The third pass should cut completely through the lower paper. You may dispense with the straightedge

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A sturdier floor-to-wall joint will result if the walls are formed as bent-up extensions of the floor. The walls can be joined as mitered reinforced butt joints. This approach might be best for shallow packages with wall seams less than 4 or 5 inches high.

flanges; the ends of these flanges should be cut at the proper angle to form a tight mi all folded inwards. After the floor is cut to size, it can be pushed in from the top and glued to the flanges to form lap joints. The exposed edges of the flanges can be protected by cutting a smaller second floor which just fits inside the area circumscribed by the flange edges and gluing it in place; this will add weight, but it more than doubles floor strength and R- approach to use if the floor is over a foot square.

Reinforcement strips should be located inside the package to present the smoothest possible surface to air and to grabby objects on the ground.

