

bottom bevels (I think) is to prevent crunching a tube fin edge when the rocket descends and contacts the ground at an angle.

Individual tube fins measure 5.0" on the inward side and 3 5/8" on the outward side. The airframe construction is self-jigging, tube fins are glued on in pairs, which assures alignment. The lower fuselage is a 36" long, 3.9" diameter LOC tube; the payload compartment is a 10" section. The coupler-bulkhead kit for the payload compartment was assembled per the LOC instructions, and the motor tube-centering assembly was epoxied together in the usual practice: one centering ring in the middle, and other two rings 1" from each end.

To anchor the recovery system, I always use a modification of the tried and true LOC method: a loop of nylon para cord is passed through a hole in the hull at least 1" below the lowest reach of the payload section coupler, with the exposed knot covered with an epoxy-filled fairing made from a plastic cigar tube. I have never had a failure or a chute snag with this method. The recovery system is then

attached to the loop and to the payload bulkhead eyebolt with small locking carabiners.

The motor tube assembly is slathered with epoxy in the usual way and inserted into the aft hull. I further anchor this by sliding down inside from the top of the body tube a spare 3.9" LOC coupler tube, epoxied to the top of the upper centering ring. I deviated from the SSS BDR scheme in using a tubular lug instead of launch rails and buttons; a 12" long piece of 1/2"

PlasterBlaster event in the SoCal desert. I selected a Pro38 4-grain I287 Smokey Sam with a 5-second delay. The photo shows a perfectly straight (and very smokey) boost, which went to about the 1100' the sims predicted. The chute tangled in the shock cord for a moment, then pulled free at about 400' AGL, mimicking a dual deployment. All-in-all, BDR 4.0 made me look better than I deserved, a perfect flight.

In April of 2004, I got around to taking my NAR L2 written test, and with Joanne Woerner, L3, as my witness, the same day flew my L2 shot with BDR 4.0 on a Pro38 J330, this time with a 7-second delay (and a more meticulously packed chute!). This time, it was picture perfect (although I didn't get a perfect picture that day, except of the recovered rocket laying undamaged in the sand). It had an impressive roar and huge white flame as long as the rocket; the flight went to about the 1620' predicted by the simulation. Unfortunately, I forgot to bring the nifty adapter I built so I could fit my tiny (18mm) MicroAlt into the cavernous BDR 4.0 payload compartment, so I have only the guesstimates of colleagues. But you can see from these numbers why no glassing or other reinforcement is needed. BDR 4.0 operates on J power like it was a big G80 sport rocket.

It's hard to imagine a simpler, cheaper, or more relaxing path to NAR Level 2. What's next? Well, according to the software, the same unreinforced BDR 4.0 design, set up for a 54mm motor tube, is capable of a 2500' flight on a Pro54 K445, hitting no more than 420 mph or 18G's, which is well within the limits of the airframe. I've calculated that the minimum motor on which BDR 4.0 will fly safely is a 38mm Aerotech H242 (short delay, of course), which should give about Estes Big Daddy performance, although a 3-grain or 4-grain Pro38 I motor would be a more reliable choice for a Level 1 shot with this rocket. L2 or L1 or just fun flying, BDR 4.0 is a lot of fun for little money or effort.

Dedication: I want to dedicate this article to my "HPR coach" and witness for the L2 certification flight, Joanna Woerner, Level 3. Joanna was our DART club VP until she died on August 19 after a brief and heroic battle with cancer. She leaves a young son, Alex Reed, and husband Andy, DART president.

Larry Brand readying his 57" scaled-down BDR 4.0 for launch.

Photo ©2003 Photos by Nadine.



BDR 4.0 boosting on a Pro 38 I287SS motor at PlasterBlaster 2003.

Photo ©2003 Photos by Nadine.



aluminum tube was epoxied to the hull 1 1/2" above the tube fin can and in line with one of the triangular holes between two of the tube fins. Finishing was with two cans of Testors spray paint, Flat Light Aircraft Gray Primer; the white plastic nose cone and payload compartment were sprayed flat white.

And that's it! As I said, about 2 hours of total work, including painting, once you stop daydreaming and get to building. Final weight with the Aeropak retainer I treated myself to: exactly 5.05 pounds. Amazing!

The first test flight was at the October 2003





The original Big Dumb Rocket, flown by the Superstition Spacemodeling Society, inspired Larry to build the scaled-down version described in this article.

Photo by Thomas Beach.

by Larry Brand

As an admirer of tube fin rocket designs, I was fascinated to read in *Sport Rocketry* a couple of years ago (Sept./Oct. 2002 issue) of the "Big Dumb Rocket" project of the Superstition Spacemodeling Society (SSS) in Arizona. This rocket, originally built as a club project for Springfest 2000, is constructed of 7.5" tubing and stands 101" high, boosting on a dual cluster of Aerotech J570's. BDR was also flown by the SSS club at Springfest 2001 and at NSL 2002. A full construction sequence and photo essay appears on the club's website at <http://www.sssrocketry.org/projects/bdr/bdr-intro.htm>.

At about this time, I had just completed my L1 flight with a triple-size Estes Goblin built from an EMRR article, and was looking at possibilities for working toward Level 2. I like to scratch build, so

*Low and Slow to Level 2:*

# Big Dumb Rocket 4.0

I was thinking about something big but not too complicated. Most L2 rockets are pricey kits or rather sophisticated scratch designs. I have always liked tube fin designs, not only because they are simple to build and inherently sturdy, but also because with all the drag associated with this kind of airframe (the drag coefficient is about three times that for a 3FNC rocket), they never go very high, slowing down after burnout as if a braking chute had been deployed. Personally, I enjoy seeing the entire flight, especially that recovery system popping out, and I don't like to chase very far after the things.

Although I had built several original tube fin models, up to G80 power, I didn't realize that a tube fin rocket could be flown on J-power, much less BDR's "K1140-power." The SSS website photos showed that construction was a piece of cake, just tubes and a motormount, no glassing and only motor-ejection for chute deployment. That clinched it—BDR would be my Level 2 ship.

As I thought things through, it occurred to me that I didn't need quite so massive an L2 rocket, and I didn't want the complexity of high-power cluster ignition, which I had never done before. Some quick calculations showed that by scaling down BDR for construction with standard 4" tubing, the result should be a 57" rocket of about five pounds. It would fly nicely on a AT J350 or a Pro38 J360 to 1600-1800 feet on a 16-18G boost at no more than 375-400 mph. No need to glass for this low performance, and the predicted altitude was low enough for dual-deployment to be unnecessary.

To confirm my ideas, I decided that I should verify CP and balance point of my 4" BDR even before starting construction. Hey, I had gone through the NARTREK program including the Gold-level design and flight-testing phases, so why not get the numbers for BDR 4.0 experimentally (although a phone call to the SSS guys would have been a lot easier)? I built a couple of small-scale BDRs, one 3/8-scale, a modified LOC Aura set up as a tube fin to fly on E30-7's, and one a 3/4-scale version made from 3" postal mailing tubes

and rigged to fly on a cluster of six D12-5's (recall that this was during the AP famine after the Aerotech fire).

The small versions flew great, especially the 6-cluster "G72" version, which I presented as a scratch design on the EMRR website (titled "Cheap Dumb Rocket"), and I decided to use the top of the "tube fin can" as the Center of Pressure, and a drag coefficient value (calculated from MicroAlt altitude data) of 2.4 was used to refine simulations for "Big Dumb Rocket 4.0." I ordered the parts for BDR 4.0 from my friendly local dealer, Andy Woerner, including a 70" Top Flight nylon chute in gaudy pink (since he had it on sale, and it was the size I needed), and got started.

## Parts list included:

- Three 36" lengths of 3.9" LOC tubing
- One 3.9" LOC bulkhead kit with eye screw
- One 3.9" LOC plastic cone
- 38mm motor tube (only 16" actually needed)
- Three 3.9" x 38mm x 1/4" ply centering rings
- 20 ft. of 5/8" tubular nylon webbing to go with my 70" chute
- One extra-large Nomex protector pad
- Two small locking carabiners

I used 5-minute epoxy throughout for construction; a safe practice in this case because of the low stresses (low for a J-powered rocket, anyway) involved. The entire airframe construction process took about 2 hours, and followed essentially that of the SSS website. Further sequence details are in the EMRR website article for "Cheap Dumb Rocket." It's hard to imagine a more idiot-proof design to scratch build than BDR 4.0.

The tube fins for BDR 4.0 were cut to a 22.5-degree bevel with a fine hacksaw and mitre box on the aft ends, duplicating the appearance of the original SSS BDR. Aesthetics aside, the purpose of the