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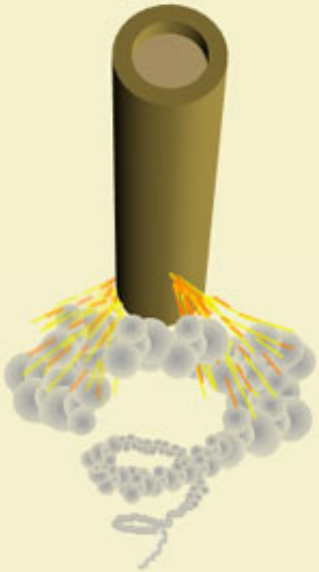
Volume 2, Issue 11

Build This...

1/2" I.D. Flying Z-Bombs.



Summary:
This fun little piece can be turned out so quickly it falls under the category of "quick pyro fix." Z-bombs are spin stabilized flying devices with salute headings. While related to the spin stabilized rockets sold under the name of Stinger Missiles, they contain no nozzle or inner core. No spindle tooling or hollow drifts are required to make them, and the finished product is nothing more than a charged tube. Unlike a buzz bomb or tourbillion, they zip up to respectable altitudes!

November, 2002 Issue

Build This:
1/2" I.D. Z-Bombs

Design Notes:
Mass Launching Z-bombs

Gallery:
4F 2002

Autopsy:
8" Ball Shell

Class C Corner:
Wild Bombardment, Starry Night

Formula: Meal powder with 6% Ti or FeTi.

Materials:

- (1) 4" or 5" long 1/2" I.D. tube with strong wall.
- (1) 3"x5" piece of 70lb kraft for star bag heading
- (1) 1-1/2" roofing nail
- (1) 4" square 3/4" thick plywood
- (1) 2" segment of 1/16" visco or chinese fuse

Tools:

- 1/2" taper tip rammer
- 1/2" flat tip rammer
- 1/2" ramming base (optional)
- 1 tsp scoop
- 1/2 tsp scoop
- 1/32" drill bit
- 9/64" drill bit

Unmeasured Materials:
powdered clay, 1/4" stars, black match, glue.

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1/2" I.D. Z-Bomb

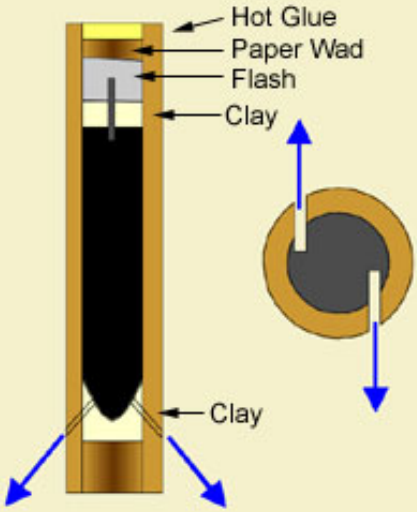

Figure 1: Side and end views of Z-bomb components and thrust vectors.

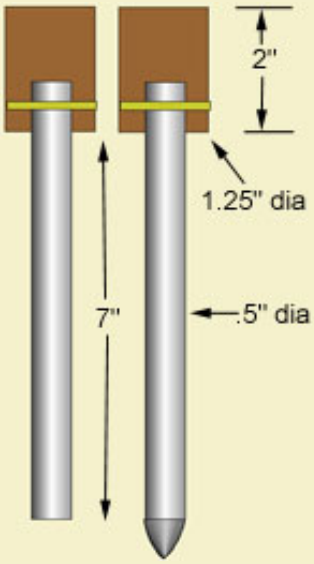

Figure 2: Home made drift set for charging Z-bombs.

Introduction:
Z-bombs are a type of spin stabilized flying device that have no fins, no stick and no venturi. They are quite compact and unassuming at first sight, but they can fly to surprising heights. These devices are probably more related to buzz bombs or tourbillions than rockets, since they rely on spin for stability during flight. They could also be described as stinger missiles (spin stabilized rockets) without the exhaust nozzle at the bottom. In fact, simply drilling a hole into the bottom plug is all it takes to convert a completed Z-bomb into a stinger missile.

Because Z-bombs do not have a strong downward thrust vector, they ascend more gradually than the lightning bolt ascent you get from a stinger missile. They tend to accelerate faster and thus fly higher than tourbillions are capable of, and they eliminate the need for the stick or wings that tourbillions require. They also create more of a buzz sound due to the high RPMs they achieve, since they spin around their long axis the way hummers or bees do.

Two opposing exhaust holes at one end of the case utilize a compound angle to provide both the spin and the downward thrust to send the tube skyward. Figure 1 shows the basic construction of the Z-bomb, along with the thrust vectors created by the angled, off-center holes.

Like most end burning spinners that utilize a side hole as an exhaust vent, a tapered clay plug is used at the vented end in order to prevent the exhaust gases from eroding the paper tube, which will increase the hole size and progressively reduce thrust during performance. Thus, a tapered rammer is needed for ramming the bottom plug.

Figure 2 shows the two rammers required to build Z-bombs. They can be easily made from 1/2" aluminum rod available in most hardware stores. The end of one rod must be tapered using a grinder or electric sander. The taper should be about 1/2" long, and should be finish sanded with emery cloth or other fine grit to remove the rough surface of the initial grinding. Failure to do this will cause the clay to grab into the grooves and make removing the rammer from the case difficult.

The aluminum rammers may be pounded on directly with a brass hammer, but this tends to flair the heads over time. I prefer to fix segments of 1-1/4" diameter oak dowel rods to the tops as a hammering surface. This preserves your tooling and also allows you to use a regular steel hammer if you want. The wooden heads are best fixed to the rods using brass pins or nails that run completely through the wood and metal rod. The use of any type of adhesive will likely not hold up under all the pounding.

The most difficult aspect of Z-bombs is getting them to launch correctly. If just placed on the ground, they will flip over on launch 50% of the time and turn into Ground Bloom Flowers. You can launch them out of tubes, but the flight path tends to be erratic. I've seen them come out of tubes at almost 90 degree angles!

The best way to launch Z-bombs is from a special launch pin similar to how stinger missiles are fired. I have modified the traditional Z-bomb design into two versions that utilize a launch pin. The first method is easier to make, but does not work as well as the second method. The smaller diameter launch pin in method #2 allows the device to spin more freely and rarely gives problems. The fat pin used in method #1 sometimes causes the Z-bomb to bind and get stuck on the pad.

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1/2" I.D. Z-Bomb

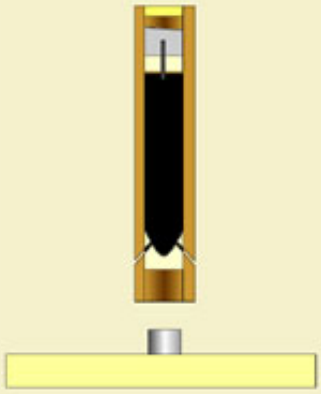

Figure 3: Launch pad and Z-bomb construction used for method #1.

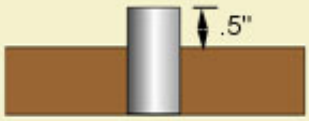

Figure 4: Raming base used for method #1.

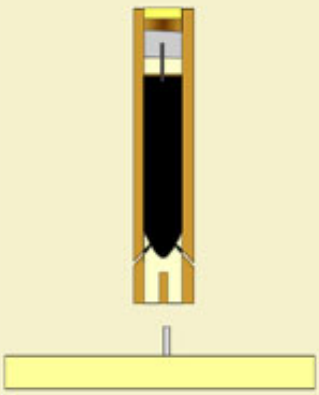

Figure 5: Launch pad and Z-bomb construction used for method #2.

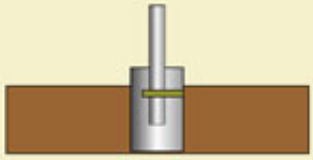

Figure 6: Raming base used for

Method #1:
The simplest launch mechanism is shown in Figure 3. The bottom plug of the Z-bomb is inset by 1/2" so that the tube can slide onto the launching base. The launch pad and the ramming base are constructed almost identically, with the launch pin being about 1/8" shorter. To make the ramming base, a 1-1/4" segment of 1/2" diameter aluminum rod is pressure fit into a 3/4" thick wooden block drilled with a 15/32" diameter hole. Similarly, the launch pad is made with a 1-1/8" segment of rod pressed into a 3/4" thick piece of wood that is at least 4" square.

A 4" long tube is placed on the base and 1 tsp of powdered clay is rammed firmly using the tapered rammer. The case is then charged in 1 tsp increments of meal. Metals such as titanium, steel or ferro titanium can be added to the meal to give a better tail. Use between 6-10% metal by weight. When using metals in the fuel, the first increment should be just plain meal, since drilling through meal with metal in it can cause a spark hazard.

Once the case is charged to about a half inch from the top, a final increment of powdered clay is rammed in place. It is important that the case be test fitted on the launch pin at this point to be sure that it can rotate freely and easily slide on and off. There is often clay caked on the inside of the tube that must be removed. Sometimes the bottom lip of the case will flair out from compression during ramming and must be reamed open again. This is easily done using a segment of 3/4" dowel with a blunt taper on one end. Failure to properly prepare the tube in this way can result in it sticking on the pin during launch.

Method #2:
The second method I devised for launching Z-bombs utilizes a smaller pin, which reduces friction and binding. This virtually eliminates problems with the Z-bomb sticking on the pad during launch. Figure 5 shows how a thick clay plug is used to create the launch pin cavity. This can be created using a special ramming base as seen in Figure 6, or the pin hole can be drilled using a drill press after the case is charged. If the hole will be drilled, then no ramming base is even required and the clay plug can be rammed flush with the end as seen in Figure 5. A 9/64" drill bit should be used if the launch pin is a 1/8" diameter nail.

Since drilling the pin hole adds an extra step, a ramming base that creates the hole is desireable. Figure 6 shows a typical home made wooden base with metal pins press fitted. The length of the 9/64" diameter pin is 1/2" above the nipple, and the 1/2" diameter nipple sticks out 1/4" above the base. Since the hole will not extend beyond the first clay increment, hollow ramming drifts are not required.

The only difference in loading this case compared with method #1 is that an

method #2.

extra 1/2 tsp of clay is used for the plug, making a total of 1-1/2 tsp of clay.

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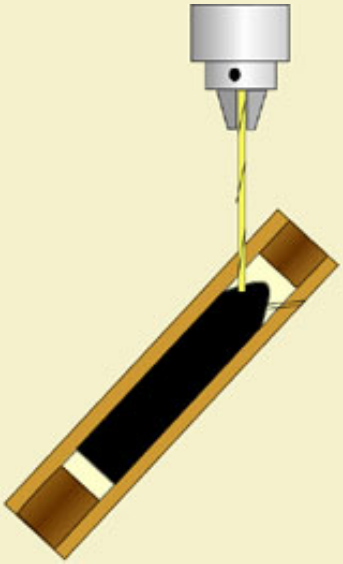

Figure 7: Free-hand drilling of exhaust vents.

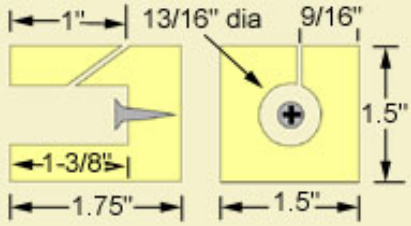

Figure 8: Guide block for drilling consistent compound angles.

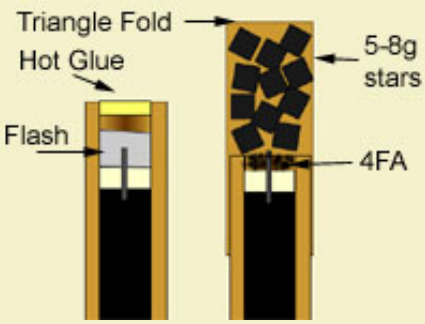

Figure 9: Salute and star headings.

Drilling Exhaust Holes:
Two 3/32" diameter holes with steep downward angles are drilled at opposing sides of the case. The need to be slightly off-center in order for the case to spin. Drilling the exhaust holes is the most critical and difficult step in making Z-bombs. The downward angle of the holes greatly effects the ascent rate and payload weight that a Z-bomb can carry.

This drilling can be done free-handed using a drill press as shown in Figure 7. The case is held with both hands at the approximate angle shown and pushed up into the spinning bit. Care must be taken to stop once the powder core is reached. You must also be careful to drill the correct end when using Method #1, since both ends will look exactly the same.

It is best to make a mark about 3/4" from the end to be drilled as the spot to begin drilling the hole. Since it is difficult to get a hole started at such a steep angle, begin by drilling slightly into the case straight on, then switch to the proper angle. This will create a dimple to keep the bit from sliding when once the case is angled down.

I'm sure determined readers will be able to drill the holes with a hand drill if that's all that is available. Regardless of how you drill the holes, a guide block as shown in Figure 8 can help with consistent hole placement and angle. The dimensions shown are for a 3/4" O.D. case where the bottom of the powder cavity sits 3/4" from the end of the case. The screw at the back of the hole is used to fine tune the position of the hole from the end of the tube. If the hole is drilled too far up, then it can enter the powder core above the clay plug and render the conical cavity useless.

Headings:
Surprisingly, this little 1/2" I.D. Z-bomb can lift a payload of 5-8 grams of stars to a respectable height. If the heading will be stars, the Z-bomb case should be about 4" long. A salute heading should use a 5" long z-bomb case that is plugged 1" short from the top. The plugs in both types are vented with a 1/8" hole and fused with a short stick of black match.

Salute headings are simply charged with flash, followed by a wad of paper and sealed off with hot glue. Star headings are made by rolling two turns of 3" wide kraft paper around the end of the case so that 2" extends to form the star bag. About 1/4 tsp of 4FA black powder is poured in first, followed by some 1/4" stars. The top is folded down using a triangle fold and held down with tape or glue if necessary.

Fusing:
These devices must be fused with a very small diameter fuse such as chinese firecracker type fuse or 1/16" diameter Visco fuse. The latter may be sold by some hobby suppliers for use as cross match, but it is ideal for use with Z-

bombs (although I don't recommend it for cross-match). The fuse is inserted into either one of the exhaust holes and held in place with a piece of tape.

While no two Z-bombs will fly the same way, they generally tend to go mostly upwards. If you bent the case during ramming, you will get an amusing cork-screw pattern. Longer Z-bombs can do other unexpected things, such as making unpredictable turns. This is definitely not a close proximity item, so use with discretion!