PEAK OF FLIGHT NEWSLETTER

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THE SILO LAUNCH SYSTEM

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APOGEE COMPONENTS

The Silo Launch System

By Bobby Potter

Some of us go to rocket launches where everyone is using a traditional launch pad, and some of us launch with Norman Pfund. You might know him as the manufacturer of the Gun Turret Launch Pad, but everyone who flies out of Pueblo will also know him from his tube.

FIGURE 1: NORMAN'S LAUNCH SYSTEM IN ACTION

This launch system has gone by a few names. The "Flamethrower," which is fitting due to the dramatic pyrotechnic show that this system provides with each launch. It's been called the "Tubular launch system", again a pretty fitting name derived from the design. We call it a Silo to be more technically accurate.

Regardless of what you call it, Norman's launch pad is pretty simple, and is probably more accurately described as a silo. It utilizes the walls of a PVC pipe to guide the rocket while it is accelerating. As this system does not have anywhere else for the exhaust of the rocket to go, the PVC tube quickly fills with flames, which shoot out of the front of the PVC just shortly before the rocket escapes. It is overly dramatic and extremely eye catching, with the acoustics to match.

The Purpose of a Launch System

When launching a model rocket, it is the air rushing over the fins that provides stability (which keeps your rocket from flying around like a loose balloon). For this to occur, the rocket has to be moving fast, and it won't be stable if it is moving too slowly for the fins to work. The minimum threshold for a stable flight is commonly regarded as 30mph. This is why you cannot launch a model rocket without some form of guide; the guide keeps the rocket upright while the rocket is picking up enough speed to be able to fly straight.

Typically we do this with a launch rail and guide buttons for high-power rocketry. For low power, you might use launch lugs and a rod for this purpose. Regardless, the goal is to get the rocket moving fast enough that the fins can take over and provide a straight trajectory. Launch rails and rail buttons have become the standard in rocketry because of the simplicity, and the ability to use the same rail for any shape and style rocket, but it is not the only way you can accomplish the task.

What is Norman's Silo Launch System?

This launch system is pretty simple, and with a couple hours and some know-how, you could pretty easily make your own. It consists of a large PVC pipe, a blast deflector, a few tie downs and a slightly modified rocket.

Norman uses this system exclusively for high-power motors. That isn't a necessity, as this system would work for any appropriately sized rocket (meaning it fits inside the tube without a ton of excess space between the fins of the rocket and the walls of the tube), but it definitely provides the loudest and most dramatic show.

The Tube

Norman has made 2 different sizes over the years, an 8in and a 6in diameter launch system. In length, the tubes both measure about 5.5 ft. This PVC tube then sits atop a blast deflector.

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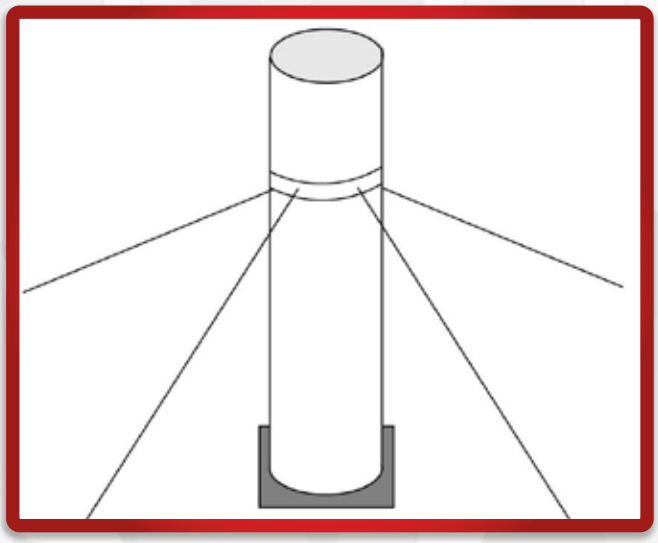

FIGURE 2: A SIMPLE SKETCH-UP OF THE TUBE DESIGN

Attached to the upper 2/3rds of the pipe is a metal bracket. This bracket encircles the PVC pipe and is used to attach 3 or 4 cables, all equidistant from each other. These cables stake into the ground similarly to what you would see as a support structure for a tent. They are there to keep the PVC tube upright and in place.

The blast deflector is just a steel plate set onto the ground. It is not physically attached to the PVC pipe, so you can easily install the starters and place your rocket into the tube while it is laying down, then turn it upright for launch.

FIGURE 3: NORMAN PREPARING HIS SYSTEM FOR LAUNCH

The Rocket

There are some considerations to be made here. Norman doesn't use any normal rocket kit here, and he actually makes the rockets that he uses in the tube launcher from scratch. Regardless of which you do, there are some adjustments you will need to make to whatever rocket you intend to launch with this.

The rocket needs some method of centering itself within the PVC pipe. Without it, the rocket may slam into the sides of the tube, the fins could get wedged against the inside of the tube and damaged, and you will lose a lot of your velocity to the friction caused by this.

To solve for this, Norman installs metal wires just under the nose cone. These wires extend out of the body tube, arch over, and then hook back into the body tube. They attach internally via holes drilled into the side of the body tube, and then are glued into place. The arch for these wires extends just past the fins and becomes the primary method of centering the front end of the rocket. As they only touch the PVC at the arch, there is very little friction.

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It also doesn't impact the rocket much visually, as they are small and you can barely see them from a safe launching distance.

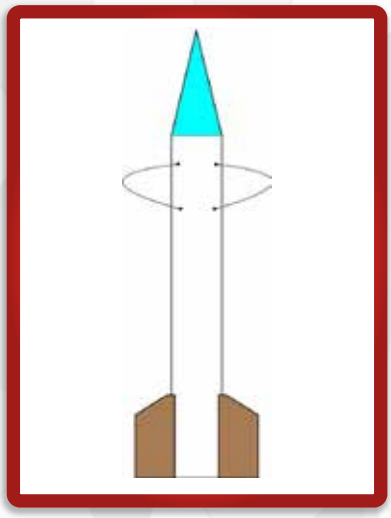

FIGURE 4: NOTE THE METAL WIRES AT THE TOP EXTEND JUST PAST THE FINS

The fins work to center the bottom half of the rocket, but it still requires a little bit of a gap between the wall of the tube and the fins. Without that gap, your fins are going to scrape all the way up the tube, greatly reducing your velocity and really scuffing up your nice paint job.

Additional Information

Unlike a standard launch pad, the rocket is in an enclosed space. Flames will engulf the rocket, and huge plumes of fire and smoke will exit out of the top of the tube, well before the rocket does.

FIGURE 5: YOU CAN SEE THE NOSE CONE OF THE ROCKET FULLY ENGULFED IN FLAME

Now that LOOKS awesome, but you should be aware that this is going to cause some damage to your rocket. Typically this will just be a discoloration, but note that discoloration is caused by incredibly high levels of heat. If you are using the wrong adhesive, or if you have any thin paper, plastic, or threads on your rocket, you could run into a more significant problem.

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FIGURE 6: NORMAN LOADING HIS ROCKET INTO THE TUBE. THIS PICTURE GIVES YOU A GOOD VIEW OF THE ROCKET HE USES AND THE DISCOLORATION THAT OCCURS.

This discoloration is also permanent. You can cover it with a new coat of paint, but you can't just clean it off. Using some of your best looking rockets is not recommended for this launch system. Do what Norm does, build a couple specifically for the tube.

Want to see some launch videos? Here is a video showing the launch system at normal speed and at ¼ speed: https://www.youtube.com/watch?v=rk2HYOb-rxc

Rocket Design Considerations

There are a few steps you should do to any rocket you are looking to use in this launch system in addition to the metal wires for centering.

First, the size of your rocket is essential. Not necessarily the tube size, but definitely the fin span. You need your rocket to have a fin span of about 5.5" (assuming a 6" PVC tube is used). This is large enough that the tail end won't be bouncing around, but small enough that the fins won't be scraping the PVC pipe all the way through the tube. This makes the design of your rocket a bit more specific. You need it to have a relatively small fin span for high power rockets, but you need to make sure your rocket is still going to be stable with that design.

Be sure to run your RockSim (www.RockSim.com) simulations to verify the stability of your design. Note that Norman uses longer than average fins on his rocket design in order to provide more area to help move the CP rearward.

But because of the smaller fin area on these rockets, you'll need to get the rocket moving faster at liftoff. So very high thrust motors are typically required. It is these high-thrust motors that put out a huge flame that you see exiting the top of the tube during launch.

Second, the wires used for centering the rocket need to be very carefully sized and installed. Sizing is the harder part, as these wires need to be just barely touching the PVC pipe. If they extend out too far from the rocket, those wires will push hard against the PVC pipe and create excessive drag. Too small and the rocket will bounce from side to side, which could cause the lower fins to try to wedge themselves into the side of the tube..

Additionally, as these wires are installed through-the-wall, the gap where these wires are inserted needs to be fully sealed back up with adhesive. Since the wires are fairly small, there isn't a lot of strength to them, and they could wiggle around, which would make it a bit more difficult to center the rocket up in the tube during launch. You'll also want to bend the ends of the wire in an "L" shape on the inside of the tube, and cover them over with epoxy so that the parachute and shock cord don't snag on them at ejection.

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Finally, the fins need a little bit of an adjustment. On the fins of your rocket, you should be rounding over any otherwise pointy or sharp edges. This is just to make sure that if your fins hit the wall of the tube, you aren't gashing into it, but instead smoothly sliding along the surface.

With all that done, you should be able to get a gorgeous launch out of this low-cost launch system.

FIGURE 7: A SUCCESSFUL LAUNCH FROM THE SILO

Parts List for the Launch System

A nominal 6" PVC Pipe like this one here: https://www.homedepot.com/p/JM-eagle-6-in-x-10-ft-PVC-Schedule-40-DWV-Foamcore-Plain-End-Pipe-10181/100346975. This does not have to be a 6" PVC pipe, and Norm has made one from an 8" PVC as well. In reality, any size of PVC pipe will work fine, provided your rocket is sized to match.

For the metal bracket, Norman used a "Hanger Strap". Something similar to: https://www.homedepot.com/p/Oatey-3-4-in-x-10-ft-Galvanized-Steel-Hanger-Strap-339232/100167964

Securing the hanger strap onto the PVC pipe can be done a bunch of different ways. Some of them come with a ratcheting system, but tightening it down too much may make it hard to attach the cables, so be sure to attach loops to the hanger strap before tightening it down. Otherwise you could use epoxy for attachment.

The blast deflector that the tube sits on can be any reasonably thick plate of steel. Norman uses his tube launcher for only high-power, and so probably uses something like this: https://www.homedepot.com/p/M-D-Building-Products-12-in-x-12-in-16-Gauge-Weldable-Sheet-56038/100248617

To hold the tube upright, Norman just uses some basic metal cables. They probably don't need to be as strong as these, but anything of a similar design to these should work: https://www.amazon.com/Tie-Down-Engineering-59539-Cables/dp/B002IVEJ7E. I like these cables as they already have the attachment points you would need to secure it to the tent stakes and hanger strap.

Don't forget your tent stakes! https://www.lowes.com/pd/Suncast-5-Pack-9-25-in-Metal-Landscape-Stake/1000576397. Any tent stakes should work well here. These will not be taking a lot of force, but rather are just there to keep the tube upright and sturdy.

And the optional perimeter flags for your lines to prevent tripping! https://www.flagandbanner.com/products/pennsp813.asp. Perimeter flags add a bit of flare to the design, and more importantly prevent anyone from tripping over the otherwise hard-to-see cables.

For the wires mounted in the rocket, we need to be a little more specific. These need to be able to bend, but they also can't be so flimsy that they can't keep their form. Norman used simple wire hangers, cut to size and bent to shape, for this purpose. This is a lighter solution, and

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seems to work well. 19-Gauge steel wire seemed like a good option to me: https://www.lowes.com/pd/Hillman-19-Gauge-Galvanized-Steel-Wire/3109493

Preparing your Rocket for Launch

Due to the design of this system, you need to take some extra care with your starter wires. They NEED to be insulated wires, as they are going to lay directly on the blast deflector. If they are not insulated, the current will transfer to the blast plate and the starter will short. Due to the direct heat from the rocket motor, these will be destroyed and cannot be re-dipped and used again.

You also need longer wires than normal. The insulated portion needs to extend out from the rocket motor, out of the tube, and away from the blast deflector. For these reasons, we recommend something like the First Fire High-Power starter. (https://www.apogeerockets.com/Rocket_Motors/AeroTech_Accessories/First_Fire_Starter) by Aerotech, or the E-matches that come with Cesaroni motors. Really, any long insulated wires will serve the purpose.

You may also want to place a block or small spacer to lift the rocket slightly off the blast deflector. This just helps to keep the starter in place when you turn the tube vertical. Remember, you won't be able to see the rocket in this launch system, so you won't be able to double check that your starter has remained in place.

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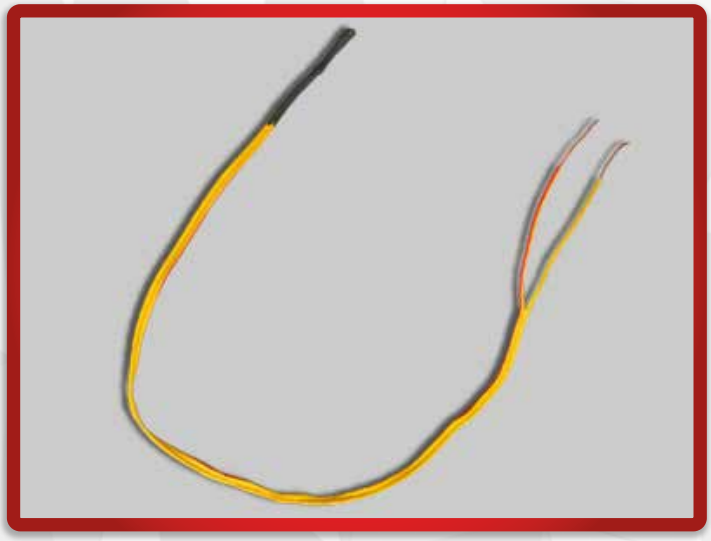
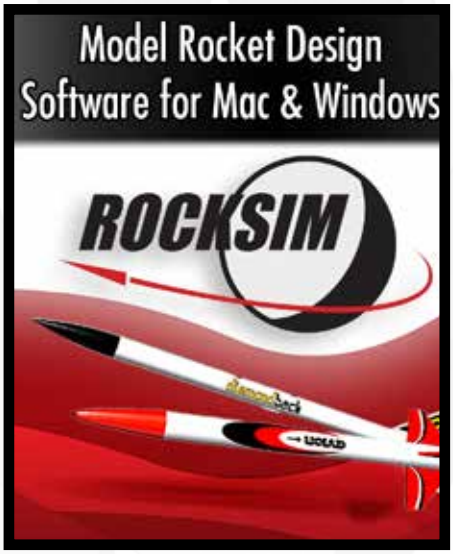


FIGURE 8: THE FIRST FIRE HIGH-POWER STARTER IS 36" IN LENGTH.



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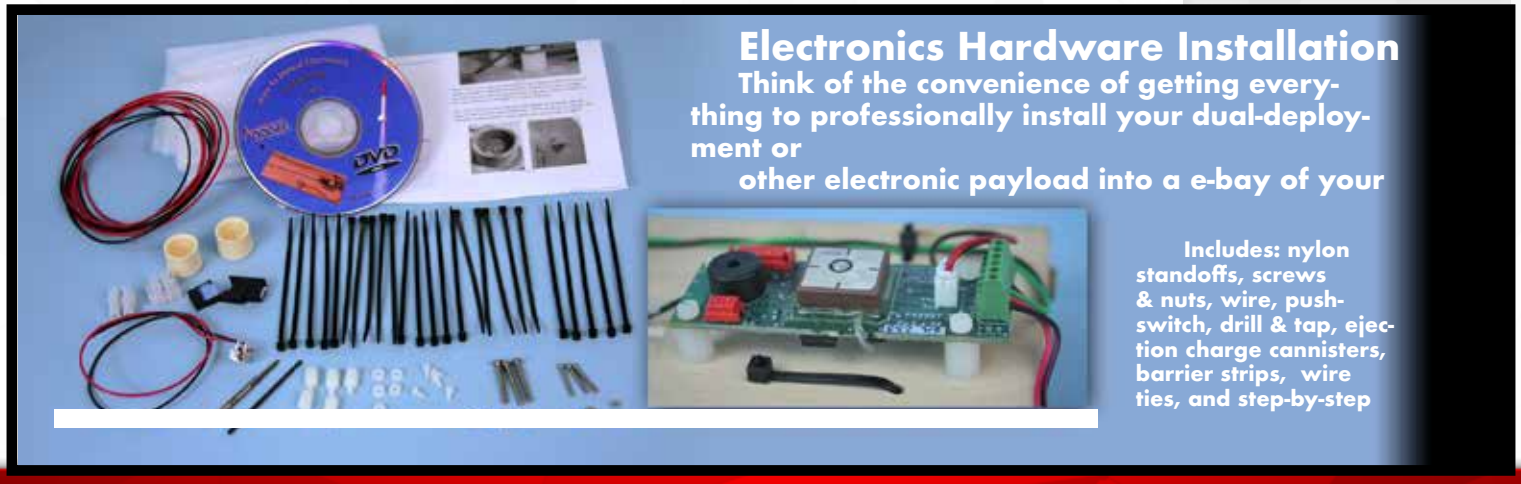

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Conclusion

Looking for a unique launch system? Silos are not used very often in our hobby, but can be quite a dramatic show. This is a fairly simple silo design, and yet it will catch the attention of everyone on your launch field.

FIGURE 9: BEST OF LUCK AND A TIP OF THE CAP FROM NORMAN HIMSELF.