activity six

Build a Very High-Powered Air Rocket Launcher

OBJECTIVE

This activity shows the senior member how to construct a rocket launcher that uses air pressures in excess of 100 psi. Paper card stock model rockets can be launched to altitudes in excess of 700 feet. This exceeds the flight capability of many solid fuel model rockets and the cost of building and flying air-powered rockets is virtually zero. This means that hundreds of launches can be made with other seniors or cadets for little or no cost after the launcher is constructed.

Captain Ryan Kubicek displays the completed advanced air rocket launcher.

BACKGROUND

Air rocketry involves the flight of rockets using compressed air as the motive force for the vehicles. This method is relatively inexpensive when compared to commercially-produced models that burn fuel contained in rocket motors. The initial cost of building a launcher is a bit "pricey;" however, from that point forward, a very large amount of aerospace education in the form of science, math and technology can be achieved for not much more than the cost of a sheet of cardstock paper!

NATIONAL SCIENCE STANDARDS

Content Standard E: Science and Technology

- Abilities of technological design

Paper Rocket Launcher © 1999

Dr. Charley Rodriguez, Ph.D.

The pneumatic rocket launcher described on the following pages was patterned after a unit used by the aviation education staff at the Waco Museum in Troy, OH. The unit depicted herein was designed and constructed to launch rockets constructed from paper, tape, and other common materials. Refer to the following document, under the heading of "Paper Rockets," presented on the internet at http://www.cap.gov/documents/newtons_laws_as_they_apply_to_rockets.pdf for additional information on rocket construction.

A WORD OF CAUTION. These rockets are extremely powerful and offer many possibilities for injury and damage to property. Consequently, immature participants should be closely monitored to eliminate misuse.

PARTS LIST

Refer to Figure 1 on this page. The index numbers on the parts list correspond to the numbered arrows on the photograph.

Index #	Description	Quantity
1.	Launch Rod Assembly[1]	1
2.	Valve, 1-inch Ball (Must be able to open in a rapid fashion.)	1
3.	Clinometer (Angle Meter)	1
4.	1-inch NPT Cap and Pipe Segment 2 1/2 inches in length	1
5.	1-inch NPT Cross	1
6.	1-inch NPT Pipe Segment 12-inches long	1
7.	1-inch NPT Cap	1
8.	1-inch NPT Pipe Segment 10-inches long	1
9.	Clamp Block, 3/4" Plywood 6' x 12" with 1/2 Circle Cut in Center Bottom	2
10.	PSI Pressure Gauge 0 to 300 PSI, 1/4" NPT	1
11.	Inflation Port	1
12.	1-inch NPT Modified Cap	1
13.	Vertical Stand (3 Pieces of 3/4" Plywood)[2]	1
14.	Base, 3/4" Plywood, 12" by 36"	1

[1] Use different size launch rods to expand the options concerning rocket body diameter. See Figure 1 additional construction details.

[2] Vertical stand is composed of three pieces of 3/4" plywood. Two members are cut to serve as the lower part of the clamp. The front board is 5 1/8" by 28 1/2" with 3/4" rabbits cut for side boards. Side boards are 6" x 28 1/2" with 1/2 circle cut into top center. Four #10 studs 4" long are used along with flat washers and wing nuts to hold launcher at desired angle during blastoff.

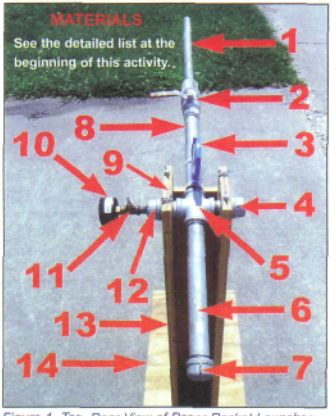
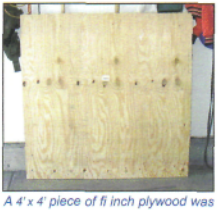


Figure 1. Top, Rear View of Paper Rocket Launcher

PROCEDURE

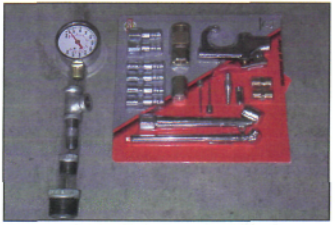
A very strong pipe must be put together which will withstand the pressure put into it by the compressor. The lead photograph in this activity is a completed launcher that was built by Capt Ryan Kubicek, Colorado Wing.

The compressor used in this activity was donated by Col Greg Cortum. It is a 12 gallon, 110 psi unit that uses power from a standard 110 v AC outlet.

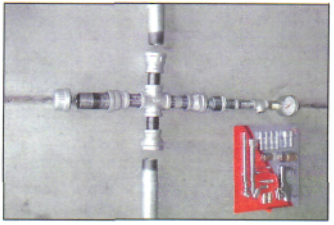


A 4' x 4' piece of fi inch plywood was purchased and used for the base and uprights that support the launcher.

The airhose and connections were purchased as a kit from a local Home Depot.



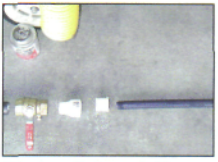
The gauge is a quality instrument capable of registering 300 psi. Just below the gauge is a fl" "T" connection, a fl" nipple, a fl-r^ reducer and a 1fl" reducer. The compressor connection kit was selected because of its quick-disconnect capability



The parts were laid out in the positions they will be assembled. Included are:

- *1 - fl" cross*
- *4 - fl" nipples*
- *4 - 1fl" reducers*
- *(Left side) 1" nipple and a 1" cap*
- *(top) 12" by 1" pipe*
- *(bottom) 10" x 1" pipe*
- *(right side) Please refer to previous photo-illustration.*

All parts of the launcher, including compressor and parts, are laid out as they will be assembled. Note the Teflon® tape and pipe joint compound - this will be used for sealing unions.



This shows the top part of the launcher. The launch "handle" is part of a 1" ball valve. There is a 1" female/male adapter and a fl" by 12" plastic pipe that will be connected to a fl" x 1" union.

The bottom section of the launcher consists of a 1" x 12" pipe with a 1" cap.

Teflon® tape is applied to one threaded section of the 1" x 12" pipe.

The end cap is now mounted and tightened so that no leaks will occur when pressurized.

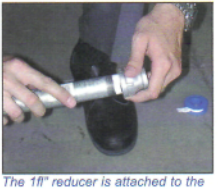
Teflon® tape is applied to the reducer nut.

This nut is attached to the reducer-nipple assembly.

The fl" -/" reducer nut is mounted to the assembly featured above.

Vise-Grips were used to make the connection tight and leak free.

The same procedure is applied to the other end of the pipe. The 1fl" reducer is fitted so that it will not leak under pressure.



The 1fl" reducer is attached to the 1" x 12" pipe. Teflon® tape is again used to help seal the threads.

The fl" nipple is inserted into the 1" x fl" reducer.

Now, the right side of the launcher is assembled using the same techniques as above.

Each set of threads is taped with Teflon®. The 1" cap is mounted to the 1" nipple. The nipple is threaded into the 1" x fl" reducer and this is attached to the fl" x 2" nipple. It is of utmost importance that care be used to seal all threadwork. A tiny leak will affect the integrity of the whole launch system.

A "tee" is attached to the assembly as shown.

Teflon® tape is now applied to the threads on the pressure gauge. This gauge is now mounted to the tee connection.

The uprights for the base unit are now measured.

A table or saber saw can be used to cut out the base pieces. These pieces are mounted into a "box" with screws. For extra strength, epoxy can be used where wood attaches to wood. When the screws are attached, it becomes a very strong mounting base that will survive many launches.

The launcher is mounted to the base and it is held in place with locking wood pieces. These wood pieces can have wing nuts installed for easy removal. This method is clearly shown in the lead photograph where Capt Kubicek is holding the assembly. One of the locking wood pieces has been removed so the reader can see how it is mounted on the upright. The compressor is hooked up to the tee connection where the pressure gauge is mounted. Once ready, the system can be tested for leaks. If leaks do occur, joint compound can be applied for additional seal protection.