CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Johanna E. Dickie

Project Number
J0107

Project Title
How Does Aperture Size Affect the Velocity and Distance of a Mechanically Created Toroidal Vortex Ring?

Abstract

Objectives/Goals
After designing and creating two types of toroidal vortex cannons, I used four different aperture sizes to test for distance and velocity of the created toroidal rings.

Methods/Materials
I constructed two different styles of vortex cannons, firing approximately 0.9 cubic meters of air, and using between 18.1 and 70.3 kilograms of triggering pressure. Four different sizes of apertures were fabricated to test the average distance and velocity of the vortex rings. I used a fog machine, stopwatch, and a 22.86 meters measured area to test each aperture size on each cannon 8 consecutive times.

Results
Two vortex cannons and various sized apertures were created to test distance and velocity of the toroidal vortices generated by each. Results showed that Vortex Cannon 1 shot its farthest reaching ring on average at 16.19 meters using a 30.48 centimeter diameter aperture. Vortex Cannon 2 shot even farther while using a 20.32 centimeter diameter aperture on average at 19.62 meters. Both cannons shot their fastest vortex rings using a 15.24 centimeter diameter aperture with Vortex Cannon 1 having the highest average velocity of 62.73 km/h.

Conclusions/Discussion
My hypothesis that the vortex ring produced would move faster and travel farther when the aperture diameter of a vortex cannon is decreased was only partially supported in my results. Generally, the smaller aperture size caused a vortex ring to increase in velocity, but the rings produced did not travel as far. Possible uses of an accurate vortex cannon could range anywhere from weaponry, assisting firefighters, or animal and crowd control.

Summary Statement
After designing and creating two types of toroidal vortex cannons, I used four different aperture sizes to test for distance and velocity of the created toroidal rings, and compared the efficiency of the cannons.

Help Received
Father helped to build both vortex cannons, and to fire the cannons during testing.