DALHOUSIE UNIVERSITY
FACULTY OF ENGINEERING

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Team 22

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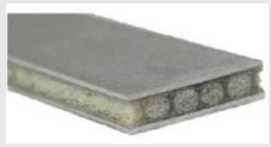
Single Stage Gas Gun

Introduction

The goal of this project was to design and create a single stage gas gun intended for use in the Advanced Composites Laboratory at Dalhousie University. Our clients for this device were Dr. Taheri and his graduate students who required this type of device to conduct ballistic impact studies on Metal-Fiber Laminate materials which they are developing.

Metal-Fiber Laminates (FML) are composed of a fiber-reinforced plastic layer sandwiched between two metal layers. This combination of materials yields high specific strength, better tolerance to fatigue crack growth, fire resistance, blunt notch strength, formability, and repairability in a lightweight package. These characteristics make FML an ideal candidate for use in armor protection as well as the automotive and aeronautic industries.



Requirements

The final device shall:

- Achieve muzzle speeds ranging from 100 – 500 m/s.
- Reproduce muzzle speeds easily.
- Accommodate projectile sizes of 5.59 mm and 7.62 mm.
- Include sufficient safety mechanisms to ensure operator safety.

Design Process

Research:

- Computational Model to estimate muzzle velocities based on various design parameters.
- Speed of sound limitations of different compressed gasses

Idea Generation:

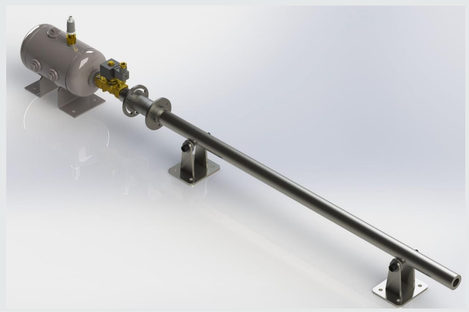
- Barrel breach designs
- System pressurization
- Firing mechanism options

Prototyping:

- SolidWorks models of parts and assemblies
- Physical prototypes limited by safety concerns

Procurement:

- Parts are largely off the shelf excluding the barrel and breach

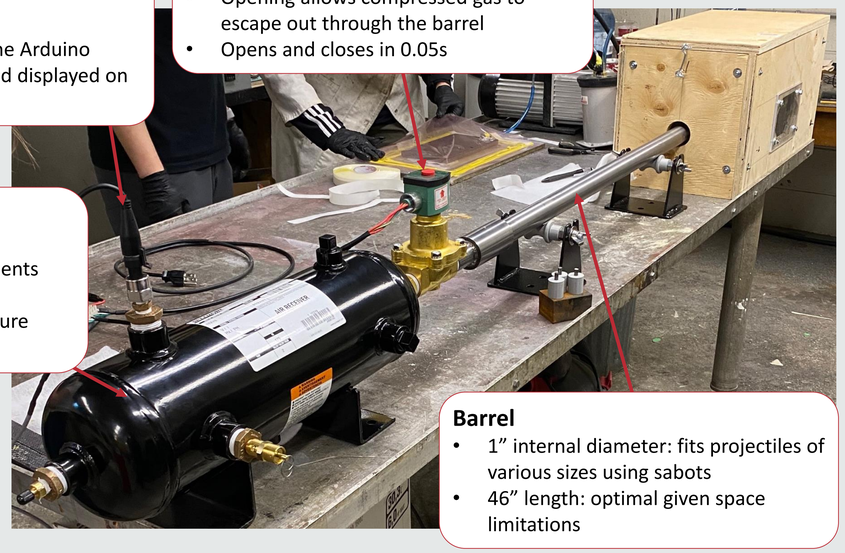


Details of Design

Pressure Transducer
- Digital pressure gauge
- Sends a digital signal to the Arduino
- Signal converted to psi and displayed on computer monitor

Solenoid Valve
- Digitally controlled valve
- Opening allows compressed gas to escape out through the barrel
- Opens and closes in 0.05s

Pressure Tank
- 2 gallon, 175psi tank
- 7 NPT inputs for components
- Schrader valve inlet
- 200spi safety valve pressure release



Barrel
- 1” internal diameter: fits projectiles of various sizes using sabots
- 46” length: optimal given space limitations

Twist-lock Barrel Breach
- Used to load rounds into barrel from the back
- Twists on and off with ease
- Airtight fitting

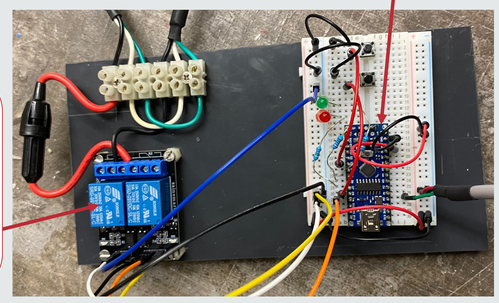
Adjustable Barrel Supports
- Holds the barrel level
- Helps to not put strain on the solenoid
- Keeps the barrel in a convenient position when reloading

Safety Box
- Used to prevent dangerous ricochet from the projectile

Sabots
- Used to fit different sized projectiles in the 1” barrel
- Sabots break off after leaving the barrel leaving just the metal projectile

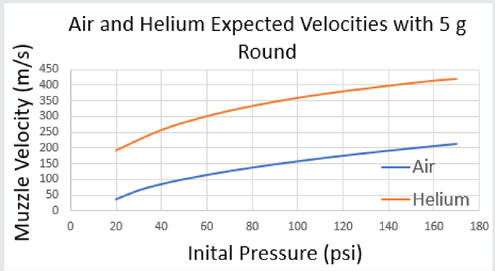
Relay
- Controls the flow of 120VAC power supply to solenoid using 5V signals sent by the Arduino
- Incorporates an in-line fuse to prevent damage to electrical components

Arduino
- Interprets the data from the pressure transducer
- Displays pressure on LCD screen
- Sends signals to the relay based on button inputs
- Pressure warning LEDs



Conclusion and Recommendations

The velocities expected to be obtainable by our device are shown in the chart below. To obtain the fastest projectile velocities Helium must be used.



Project Status

- Design and Fabrication ✓
- Assembly ✓
- System Testing ✓
- Preliminary Low-pressure Testing ✓
- Full Speed Testing – In progress

Potential Upgrades

In order to utilize this device to its maximum capacity the following upgrades should be considered.

Upgrade	Impact
Higher Pressure Tank & Solenoid	Larger velocities obtainable
Longer Barrel	Larger velocities obtainable
Additional Barrels with Varying Diameters	Ability to fire a larger range of projectiles
Steel Safety Box	Reduce risk of puncture
Enclosed Compartment for Electronics	Reduce risk of shock & contaminants

Recommendations

Once the device is intended to be used it should be secured to the table on which it sits. This will increase the ease of use and decrease the risk of injury through use.

References

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