TACLABS Reciprocating Firing Pin System and Analysis

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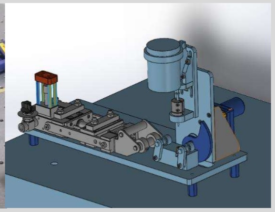
PROJECT BACKGROUND

- TACLABS Mission:
  - A technology to help solve gun crimes, identify gun trafficking networks and reduce gun violence.
  - Incorporate the use of micro stamped shell casings in order to track and deter.
- Problem and Criterion:
  - Develop a force stamping mechanism that will simulate a firing pin hitting the brass primer on a bullet casing for several 1000 repetitions to test the strength of micro stamped firing pins
  - Firing pin must be removable.
  - Must be able to be used for an M1911 pin and AR-15 pin.
  - Develop a numerical model to understand the wear on the firing pin throughout the lifecycle testing.
- Existing Design:
  - Relies on a gravity based force.
  - Applies force based on a set period.
  - Does not replicate the force of a weapon's hammer accurately enough to a realistic firearm scenario

Original Stamping Mechanism



CAD Model of Mechanism

DESIGN IDEAS

Three different designs were used in order to simulate the force on a firing pin

- Pneumatic: this would rely on air pressure in order to direct enough force.

- Mechanical: this would use a spring force in order to simulate the force.

- Gravity: this would use an estimated amount of weight to simulate the force.

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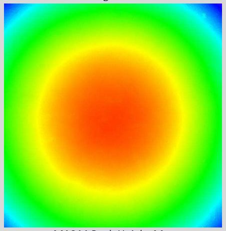
FIRING PIN ANALYSIS

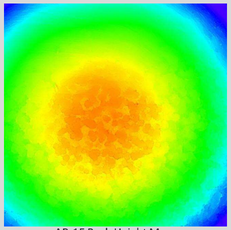
- Two types of firing pins were put under a confocal microscope to measure surface roughness and to understand the microstructure of each pin.
- A peak height map can best explain the machining quality of each pin and give insight into the microstructure allowing for a numerical model to be estimated.

M1911 Firing Pin Finish

AR-15 Firing Pin Finish



M1911 Peak Height Map



AR-15 Peak Height Map

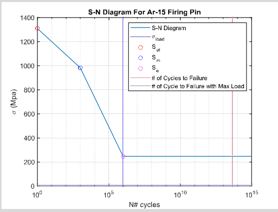
Firing Pin	Average Surface Roughness
M1911	0.513 µm
AR-15	1.925 µm

- Micro-Hardness testing was performed with help from the University Instrumentation Center on the two firing pins using a micro-indenter. The Modulus of Elasticity and hardness were determined.

Firing Pin	Average Hardness
M1911	6.92 GPa
AR-15	6.17 GPa

NUMERICAL ESTIMATION

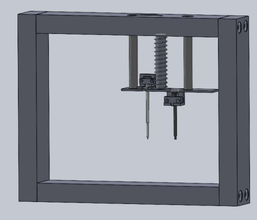
- To estimate a wear model with the known information of the material and loading scenario, a stress life fatigue analysis was utilized to estimate cycle life of the firing pin. An S-N diagram for the AR-15 case was created as it has the more conservative stress indicators.



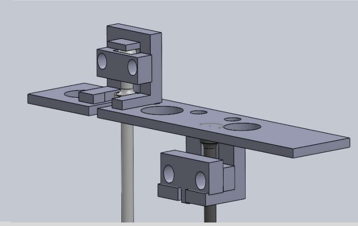
- Under the current loading the firing pin will experience a theoretical infinite life cycle, however accounting for poor manufacturing and brass debris run-off which are two common industry occurrences the estimated cycle life per pin was found to be in the range of 50-60 thousand cycles.
- This model was estimated using a method of predicting random occurrences of machine failure within a given life-cycle period.

FINISHED DESIGN/MODEL

The finished model relies on a spring in order to apply force to the firing pin. A pneumatic actuator integrated into the existing indexing system will reset the spring to its compressed length. A dual sided firing pin mount holds both pin specifications without changing the mount mass or dimensions.



Final Design Iteration



Fixture that houses both pins

Air cylinder utilized to reset system

CONCLUSIONS

The model designed will release the same amount of force as would be applied to both weapons and will be able to be repeated several hundred times. The spring and firing pins can be swapped out between iterations for replacement as necessary.

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