

Nightforce Optics was established in 1992 with the goal of building the finest riflescope in the world. Incorporated in Ontario, Canada, Nightforce engineers, manufacturers, and imports many different optics and accessories, ensuring that all will be rugged, reliable and repeatable.

Design and fabricate an impact test stand to evaluate riflescopes

Requirements

Each and every Nightforce® riflescope is currently impacted as it goes through the production line. This is currently accomplished by impacting the riflescope on a padded steel pedestal in multiple orientations. After impact the riflescope is checked to make sure nothing internally has shifted. Each person on the production line impacts their own riflescope which means the probability of inconsistencies is high.



Design Requirements:

- Adjustable Impact Force: 500g, 1000g, 1500g, 2000g, 2500g
- Adjustable Impact Directions: Side, Top, Bottom, Front, Back
- Size of 2'x2'x2'
- Weight: 100kg
- Capacity of Side and Forward Impact
- Data Collection/Output for LabVIEW, Test and Go Force
- Non-Destructive
- Full Drawing, Assembly, and Set Up Data including Calibration Method

Specification	Threshold	Objective
Force applied to scope	500g-2500g	200-2500g
Impact modes	Single	Single and Cyclic (3 Repetitions)
Impact Angles	All four sides and forward impact	360° capability
Calibration	Can be calibrated to specific forces	Don't have to have computer
Scope removal while testing	Scope is removed and attached after each side impact then after each side impact there is a final GSR followed by a final forward impact	
Size of machine	2'x2'x2'	2'x2'x2'
Data collection	Output to laptop/Ram drive, time, and G force. Also impulse	Real time output to external screen
Different sizes of scopes	Attachment method for 30mm and 34mm diameter tubes	Single, adjustable attachment method
Machine use	Research and develop. Proof of concept	Production flow ready
Primary operation	Anyone. Should be able to operate by a minute	
Time?	As needed	500g (time it takes to do full range test)
Safety concerns	Can't automatically or unintentionally go off	Additional safety guard to protect operator's hands or fingers
Surface Conditions	Can't damage the surface or bend the trim ring	

Consistent Hit

Members: Jay Anderson, Jason Borth, Dillon Glover, Kylie Touchstone

Faculty: Michael Maughan
Mentor: Dillon Savage
Sponsor: Nightforce Optics

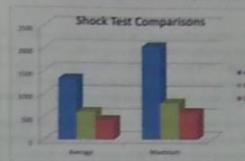


Mission Statement: Creating a R&D prototype to apply a consistent impulse of acceleration for impact testing of rifle scopes.

Design and Impact Testing Inventory

NIGHTFORCE

1. Shock Test Comparison Results



2. Impact testing results from March 2013 observation

- Maximum = 2041 g
- Minimum = 695 g
- Average = 1235 g
- Std. = 317 g

	Overall
Name	Max
Cameron	1980
Christopher	2000
David	2270
Dave	945
Dillon	2395
Josh	1995
Kyley	1995
Overall	Avg 1200

Page 2 of 4

Fighting out force and position needed.

More impact force without hitting

G force is a type of acceleration that can be measured with an accelerometer. $\text{G} = \frac{\text{F}}{\text{m}}$

G force multiplied by a mass open when it acts on a certain type of mechanical force.

Need to find the average mass of the scope we will be working with.

Page 20 states for the masses for each scope. Average mass is 1.4 kg around 1200g/kg.

$F = m \cdot a = 1.4 \text{kg} \times 1200 \text{g}/\text{kg} = 1680 \text{N} = 168 \text{kg}$ or 320lb

Work Energy Principle

The change in the kinetic energy of an object is equal to the net work done on the object.

Average impact force x Distance traveled = Change in kinetic energy

$$F \cdot d = \frac{1}{2} m v^2$$

Divide by mass to obtain acceleration

$$\frac{F \cdot d}{m} = a$$

A 5kg scope moving at 120cm/s (22 mph) stopped in 200m of padding would equal an average force of 120 N (2200N/m)

Divide by mass to obtain acceleration

$$\frac{120 \text{ N}}{5 \text{ kg}} = 24 \text{ m/s}^2$$

Divide by mass to obtain acceleration

$$\frac{24 \text{ m/s}^2}{1.4 \text{ kg}} = 17 \text{ g}$$

2-28-15

