

A collage of military-related images: a soldier in full combat gear on the left, a large naval ship in the center, a fighter jet in the sky, and a missile launch with a large plume of fire on the right. A blue and yellow curved graphic element is at the bottom.

# HARNESSING THE POWER OF TECHNOLOGY for the **WARFIGHTER**

*CAPT JT Elder, USN  
Commanding Officer  
NSWC Crane*

## *Development of an Integral Suppressor for the M4A1 Carbine*

*Presented By: Jason M. Davis*

*April 28, 2016*

*Ms. Patricia Herndon  
Technical Director (Acting)  
NSWC Crane*

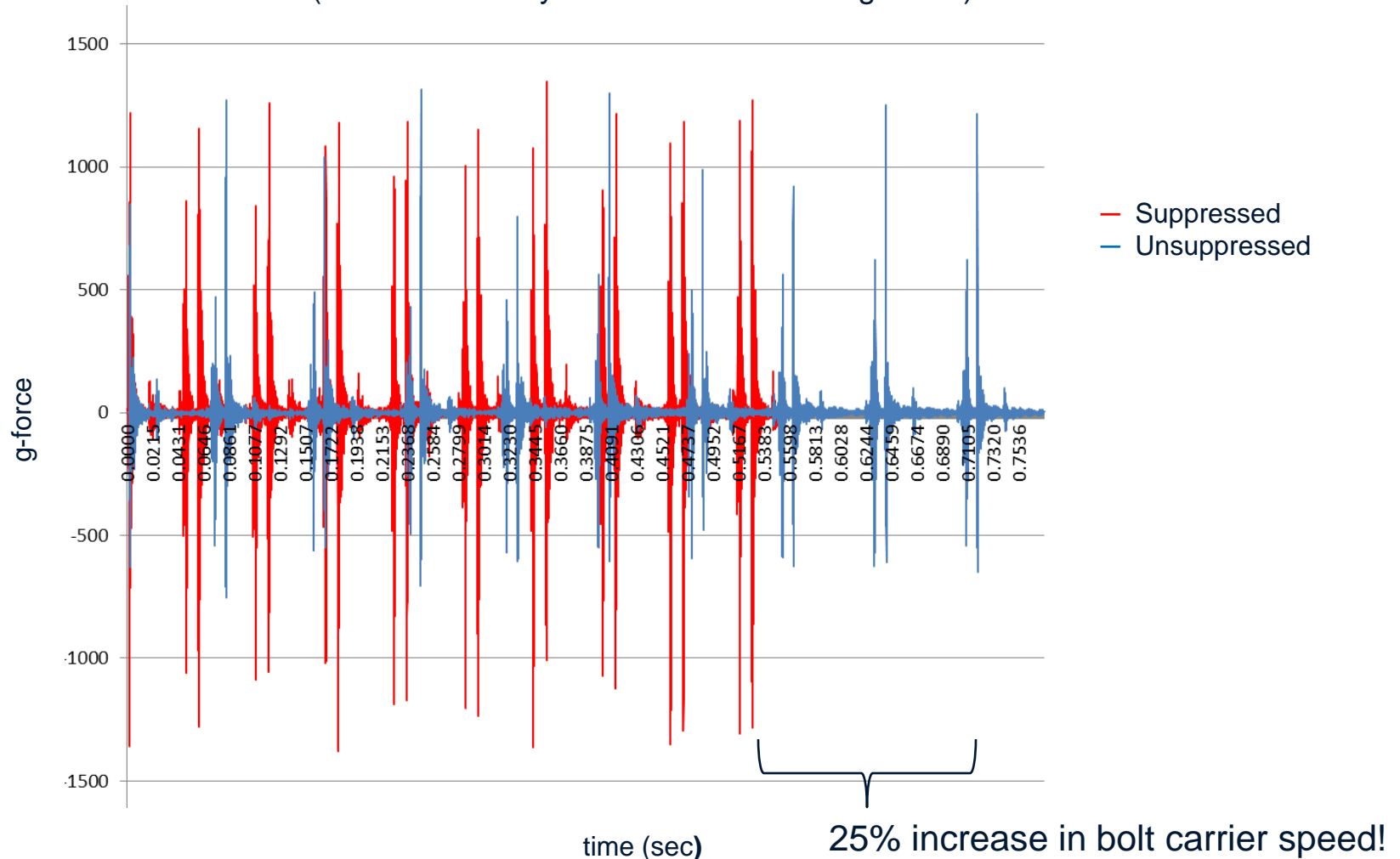


# Overview

- Motivation for Invention
- Conceptual Framework
- Prototype Development
- Performance
- Path Forward

# Effects of Traditional Sound Suppression on Weapon Systems

Comparison of Shock Profiles for the M4A1 Carbine:  
 Suppressed vs. Unsuppressed  
 (10 Shots in Fully Automatic Mode using M855)



Distribution Statement A: Approved for Public Release; Distribution is unlimited.

# Effects of Traditional Sound Suppression on Weapon Systems

Initial

Shot 1

Shot 2



Shot 3

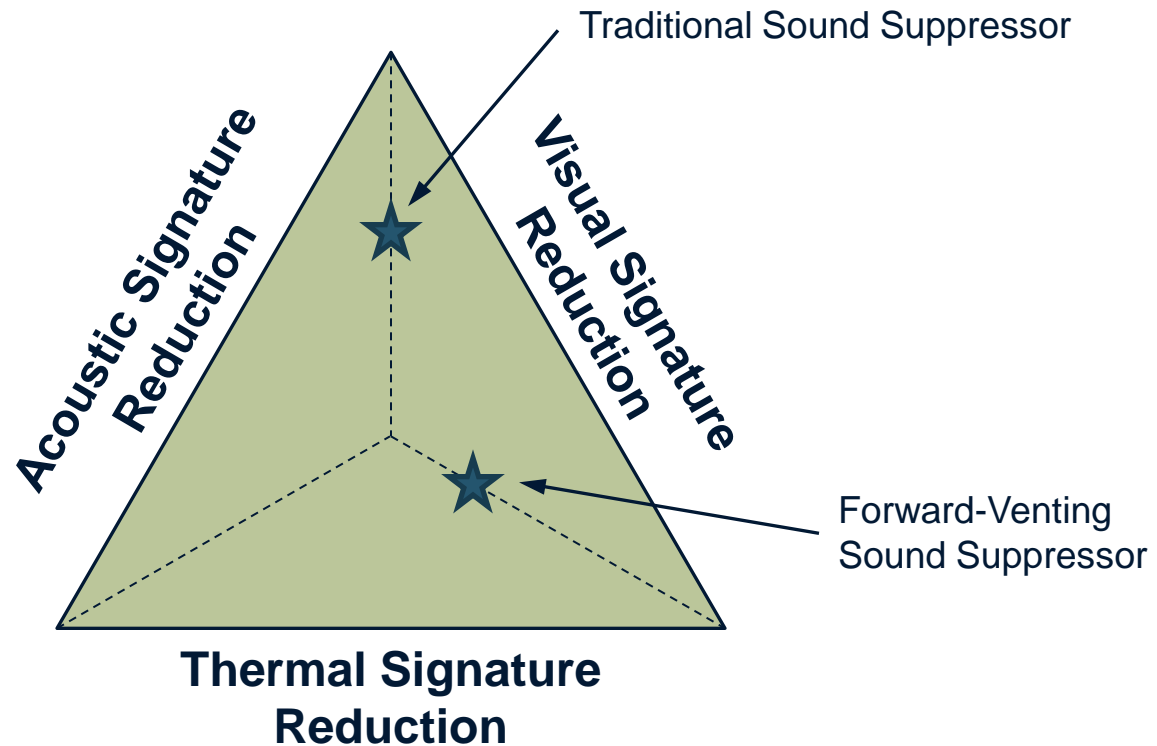
Shot 4

Shot 5



# Inseparable Signature Components

## Conceptual Model: Sound Suppressor Performance Triangle

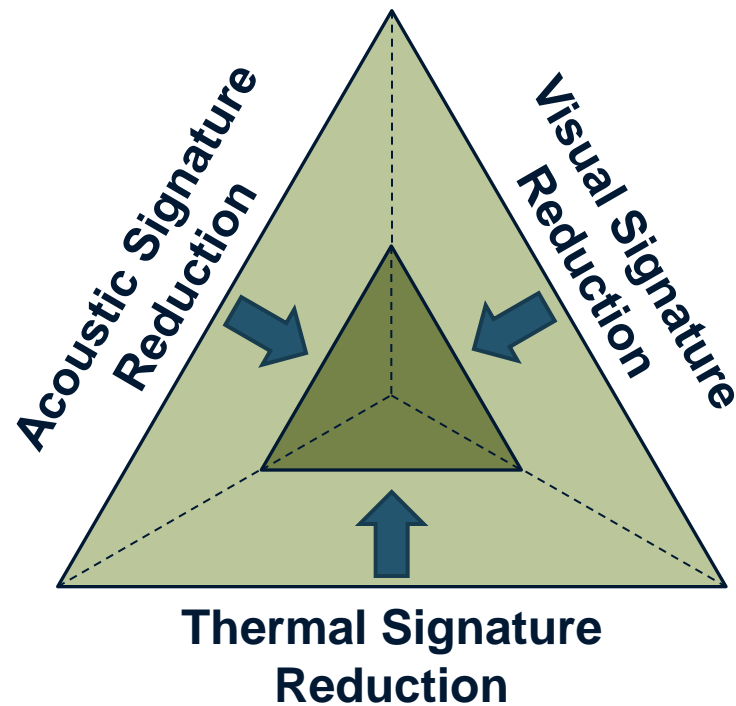


*Pick any 2!*

# Inseparable Signature Components

**Question:** How do you overcome these interdependencies?

**Answer:** *You don't! But you can shrink the triangle...*



# Some Thoughts to Consider

- Amount of combustion gas contributes directly to flash, acoustic, and thermal signature.
- For fully-automatic weapons, only require sufficient amount of combustion gas to cycle weapon and propel bullet; all other gas is excess.

# How It Works

- The Integrally Suppressed Upper Receiver Group takes a true systems approach to weapon suppression
- Basic concept:
  - Reduce volume of gas exiting the muzzle by redirecting a portion of the gas to another exit
  - Less gas exiting muzzle means: less flash, less heat, and less sound
  - During redirection, gas is being expanded, slowed, and cooled to avoid secondary flash and sound signature





# Requirements for Use

- Properly ported barrel
- Free-float rail system with a minimum inner diameter of 1.75"
- Integral Suppressor replaces gas block
- Agnostic to flash hider
- All other weapon components remain the same

# Advantages

- No additional length added to weapon
  - Suppressor contained entirely beneath rail system
- Center of Mass moved toward shooter
- Any flash hider and/or traditional muzzle-mount sound suppressor can be used as well
- When used in conjunction with integral suppressor, traditional muzzle-mount sound suppressors will:
  - stay cleaner longer
  - heat up slower (reduce thermal signature)
  - result in lower back pressure than when used alone
- Government owned design:
  - Patent No.: 9,273,920
  - Patent Date: Mar. 1, 2016



# Progress to Date

- Working prototype has been developed by the Small Arms Weapons Division at NSWC Crane for the M4A1 Carbine (14.5" barrel).
- Prototype is currently in its 5<sup>th</sup> design iteration.
- Minimal changes have been made to the original weapon system. Only the barrel, gas block, and rail system have been modified.
- Test data exists for flash signature, thermal signature, accuracy, and muzzle velocity.

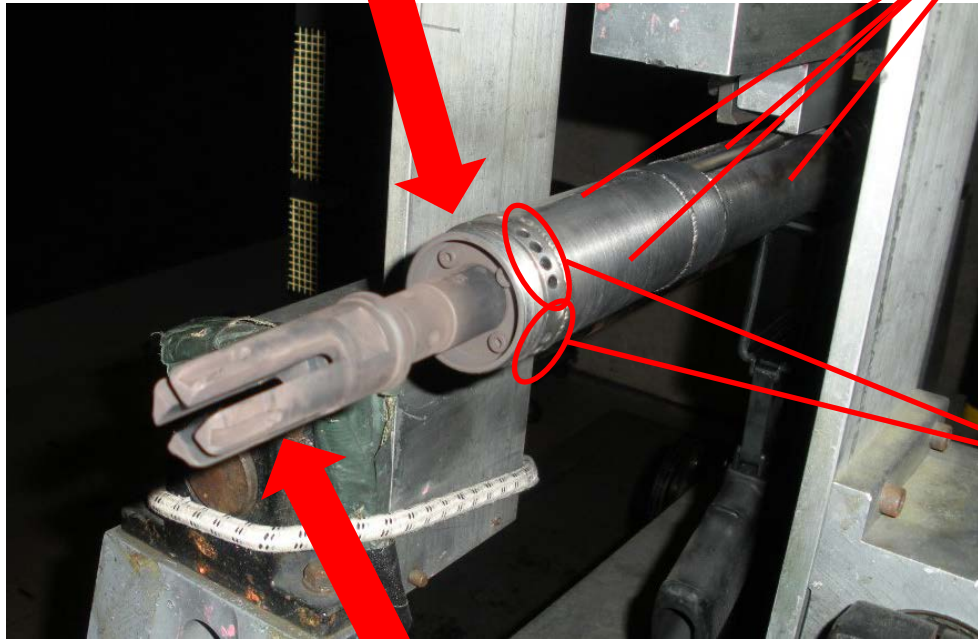
# Progress to Date

- Working prototype has been developed by the Small Arms Weapons Division at NSWC Crane for the M4A1 Carbine (14.5” barrel).
- Prototype is currently in its 5<sup>th</sup> design iteration.
- Minimal changes have been made to the original weapon system. Only the barrel, gas block, and rail system have been modified.
- Test data exists for flash signature, thermal signature, accuracy, and muzzle velocity.

# Design Features

Threaded portion to accept  
screw-on reflex sound suppressor

Four distinct chambers –  
2 forward of gas block,  
2 rearward of gas block



Exhaust  
ports

Flash hider capable of  
accepting sound suppressor

# Without Flash Hider

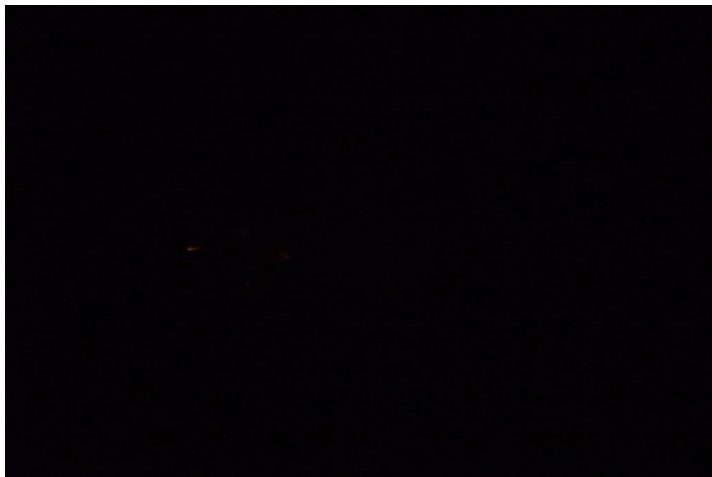
Typical fireball  
without a flash hider

Gas exiting ports



# Prototype Flash Signature

In order to capture an image of the flash signature, the Digital SLR Camera was set to ISO 6400. *Six times more sensitive than the human eye!*



Example of one of the lowest intensity flash photos.



Example of one of the highest intensity flash photos.



0.2 – 0.3 mJ/sr

MK18 with Traditional Muzzle  
Mount Sound Suppressor



0.03 – 0.07 mJ/sr

Integrally Suppressed URG



- Thermal signature data has been collected but is still being processed.
- Acoustic data was collected for earlier prototypes but must be measured again for current prototype.



# Prototype Accuracy & Velocity

- Accuracy at 100 yds using M855A1 (10 rounds):
  - 3-inch group size
- Average velocity (@ 100 yds):
  - 2,620 ft/sec

# Path Forward

- External funding is now being sought for further development and refinement.
- Interested in partnering with industry, Government, and academia
- Next step is to reduce length of barrel and integral suppressor. Proposed barrel length design envelope: 11.5 – 13.0 inches
- NSWC Crane now has a 3D printer that can print metal, among them Inconel. This additive manufacturing capability has opened up new design possibilities that were previously too complex and too expensive to incorporate.

# Contact Information



Jason M. Davis  
Project Principal Investigator  
NSWC Crane  
300 Hwy 361  
Code JXNR, B-3422  
Crane, IN 47522  
(812) 854-6855  
jason.m.davis3@navy.mil

David R. Long  
Chief Engineer  
NSWC Crane  
300 Hwy 361  
Code JXN  
Crane, IN 47522  
(812) 854-3542  
david.r.long@navy.mil