Always a Step Ahead

ARDEC ARMAMENTS

LASER DIODE IGNITION

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UNPARALLELED COMMITMENT & SOLUTIONS

Act like someone's life depends on what we do.

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A History for Laser Ignition

Crusader 1980's-1990's

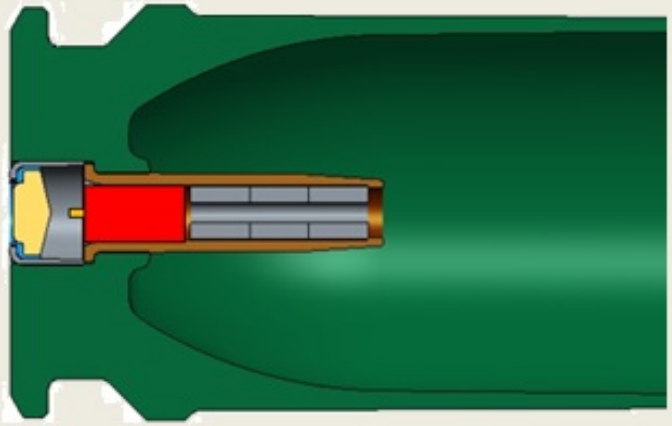
LW155 Artillery 1990's - 2012

Laser Ignition is NOT new; Efforts began in the 1960's

- External high power lasers shooting through a window
- Highly successful programs, (from a laser technology perspective)
- Over 25,000 rounds fired on the Crusader using laser ignition
- Over 5,000 rounds fired on the LW155 using laser ignition[2]

A History for Laser Ignition

2000- Present



- Laser diode technology begins around 1995
- Technology continues to evolve along with commercial applications
- Very small and mass producible. Similar processing used in IC production.
- Tremendous cost reduction over flash lamp pumped systems
- The entire laser can easily fit inside the space for a standard 30mm primer cup

What has changed since the 80's?

- User requirements / desires
  - Increased threat of Electronic Warfare, i.e, RF, ESD, E^3 effects
  - A desire for alternative (green) energetics (Lead Free)
  - The need to have 'smarter' munitions at the lowest cost per round
  - The need to be able to communicate with, and program, munitions
  - Reliability (10,000 hours MTBF)
  - Disposable, environmentally benign materials.
  - Fire control systems that enable coincidence based engagement *

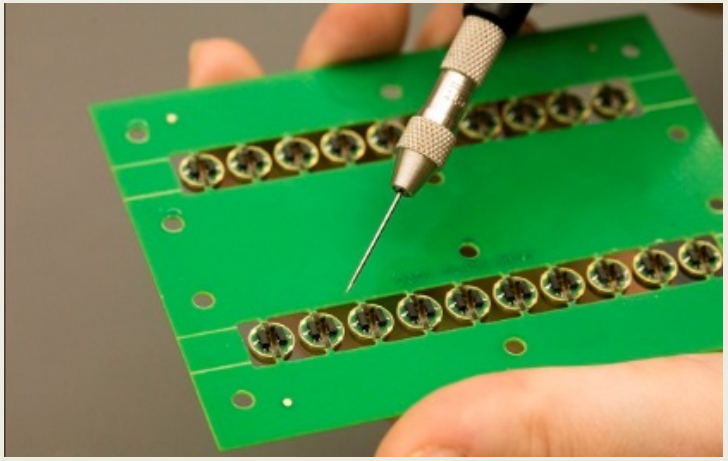
  * TrackingPoint ™ concept elimination of mechanical shear

- Technology
  - Commercial availability of laser diodes
  - Power and efficiency of laser diode technology
  - Surface Mount Technology (SMT) and automated assembly on large scales
  - Micro-miniaturization

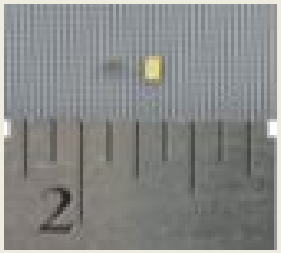
What has been demonstrated/accomplished?

- Demonstrated to pass HERO
- COT's supply, commercial manufacturing and carrier shipping
- Physical separation between energetic from ignition source/electrical stimuli
- Laser Diode emitter can be tested and re-tested to assure functionality
- US based supply of diode lasers: in many energy levels and wavelengths
- Compatibility with novel energetics
- Eliminates lead based compounds
- Mechanical part reduction
- Seamlessly compatible with many existing electric ignition systems
- SMT (Surface Mount Technology) compatible assembly
- ARDEC patented technology (2 complete primary, 8 pending supplemental)
- Coordinated fires, enhanced coincidence

ARDEC MANUFACTURING EFFORT



Surface mounting of electronics and laser diodes



Laser Diode

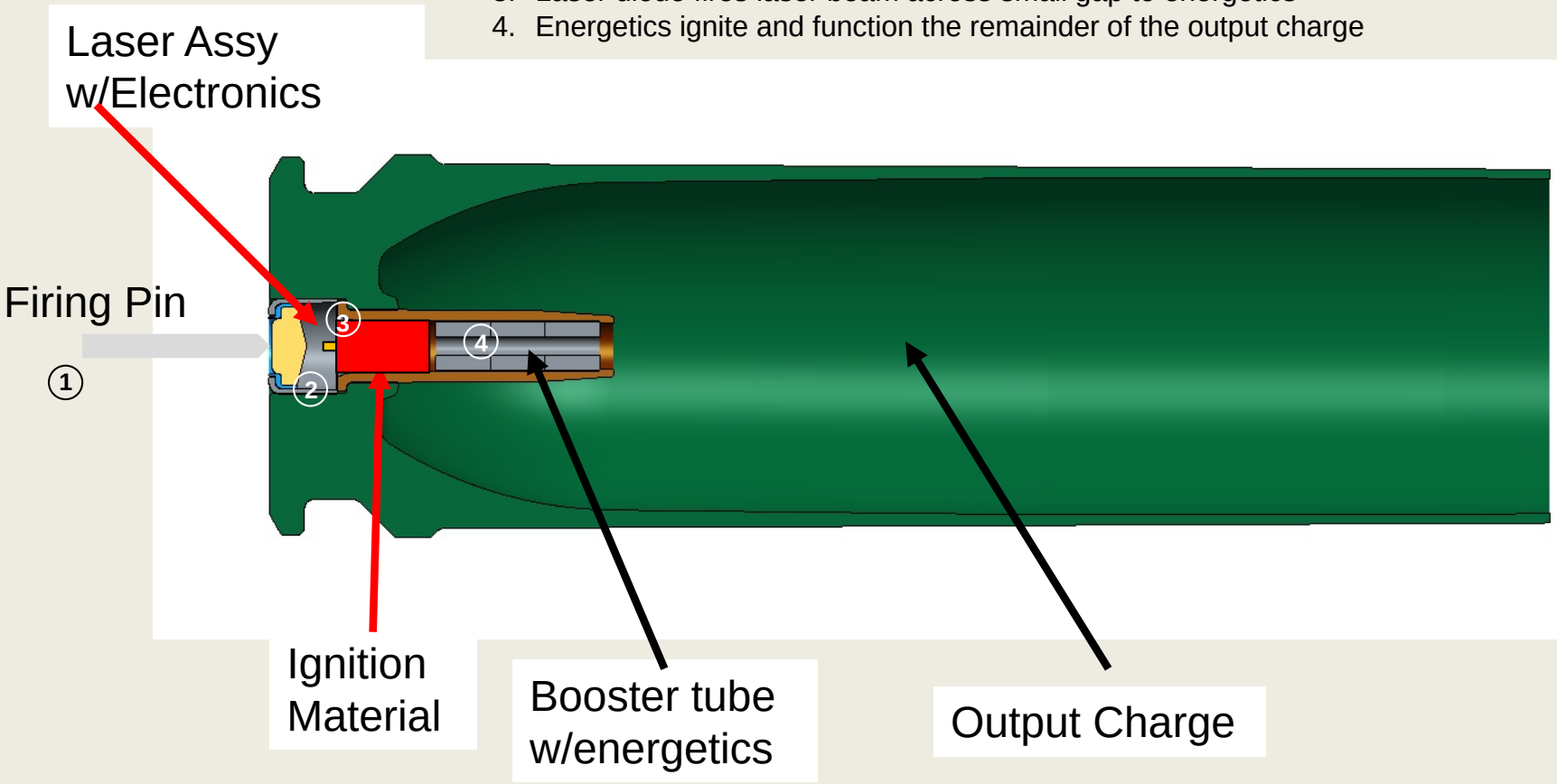
Assembly mounting, post potting

Finish and tested laser diode primer

Packed primers ready for shipping

TYPICAL FIRING SEQUENCE

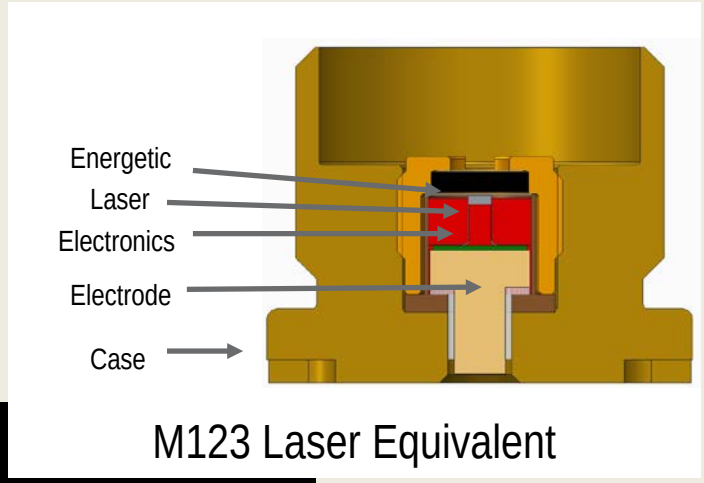
1. Standard electrical firing pulse delivered from firing pin
2. Sufficient amperage delivered to activate laser diode
3. Laser diode fires laser beam across small gap to energetics
4. Energetics ignite and function the remainder of the output charge



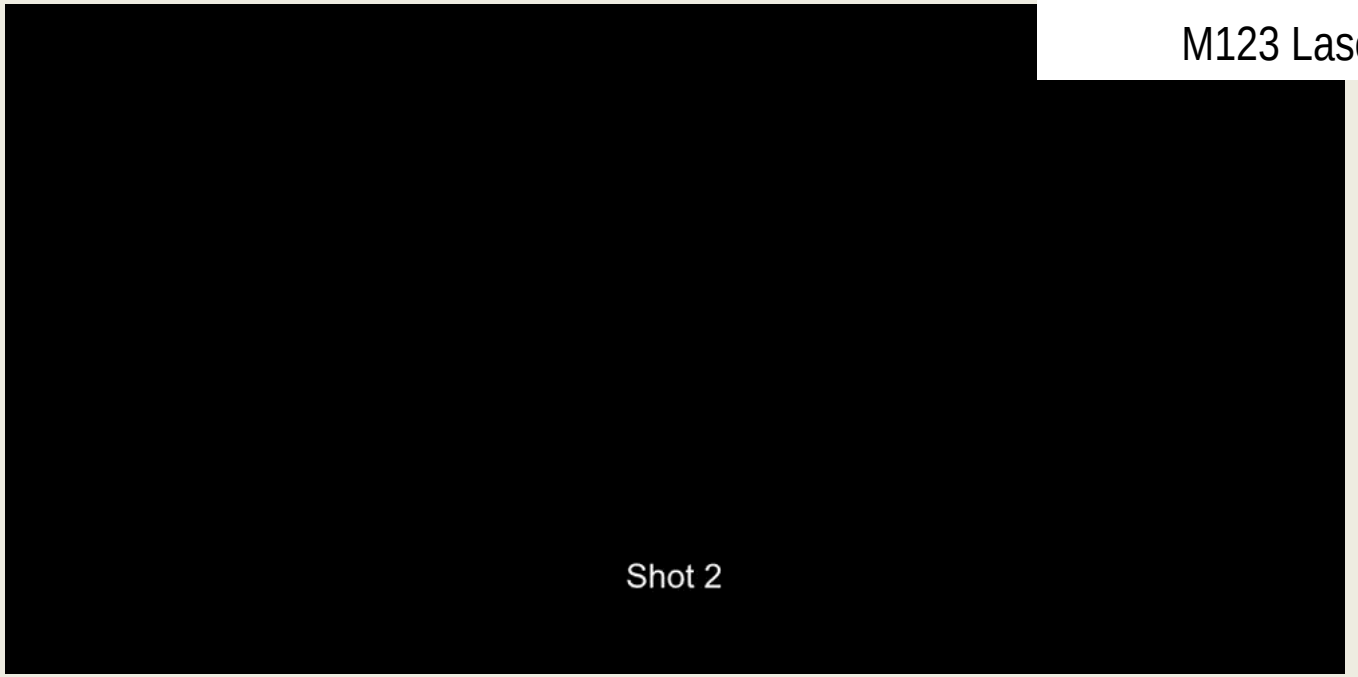
M230 VIDEO

LARGE CALIBER PRIMERS

Ignition of Black powder in a 120mm cartridge



M123 Laser Equivalent



•Benefits

- Replaces bridge wire and ignition mix with electronics and a laser diode
  - The initiator becomes an inert element
  - Can be manufactured by any contract manufacturer
  - Shipping and handling not an issue
  - Can be fully tested prior to cartridge assembly
  - Can be verified after cartridge assembly
- HERO Compliant
  - Laser can only be initiated at prescribed current
  - Current threshold can be tuned
- An enabling technology for smart ammo
  - Embedded logistics
  - Lockable ammo
  - Sensor data for precision fires
- Commonality between large caliber platforms

LASER IGNITION

- **Who can make a laser primer**
  - Anybody. The Army owns the patent and can license commercial applications or other military applications.
- **Who may want the technology (besides the military)**
  - Mining Industry
  - Automotive Industry (i.e. air bag deployment)
  - Fireworks Industry
  - Demolition / Rescue
- **Why don't we have it**
  - Lack of infrastructure for mass production
  - Reluctance to adopt new technology

- Conclusions
  - Lasers can replace bridge wire technology
    - Drop in replacement for 30mm electric primer
  - Separation of energetics from the ignitor can increase the manufacturing base for ammunition
  - HERO safety can be achieved
  - An enabling technology for smart munitions
- Questions?