Performance Testing of Lead-Free Stab Detonators

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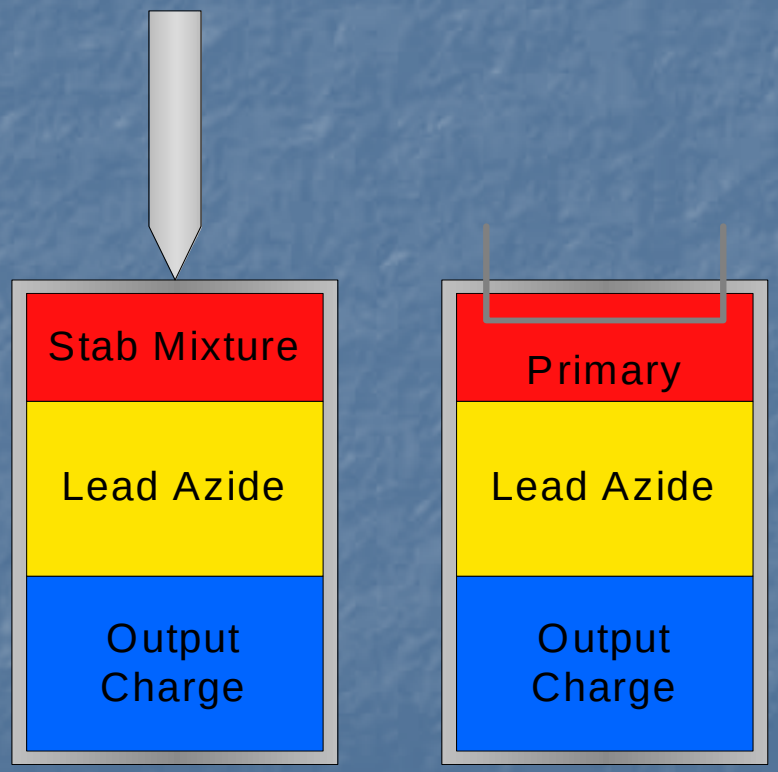
Outline

- Introduction
- Objective
- Initiating Charge Replacements
- Transfer Charge Replacements
- New Detonator Design
- Benefits
- Test Results and Comparison
- Questions

Introduction

- Current issues with primary explosives in detonators:
  - No US Lead Azide production
  - Environmentally hazardous
- Initiated a program to develop a lead-free stab detonator



Program Objectives

- Replace NOL-130 (initiating charge) and Lead Azide (transfer charge) with green materials.

Initiating Charge Replacements

- Replacing the initiating charge will eliminate some of the lead
  - Must initiate with same stimulus
  - Must be powerful enough to cause transfer charge to detonate
- Lead-free stab mixture
  - Based on NOL-130
  - Lead-based components replaced

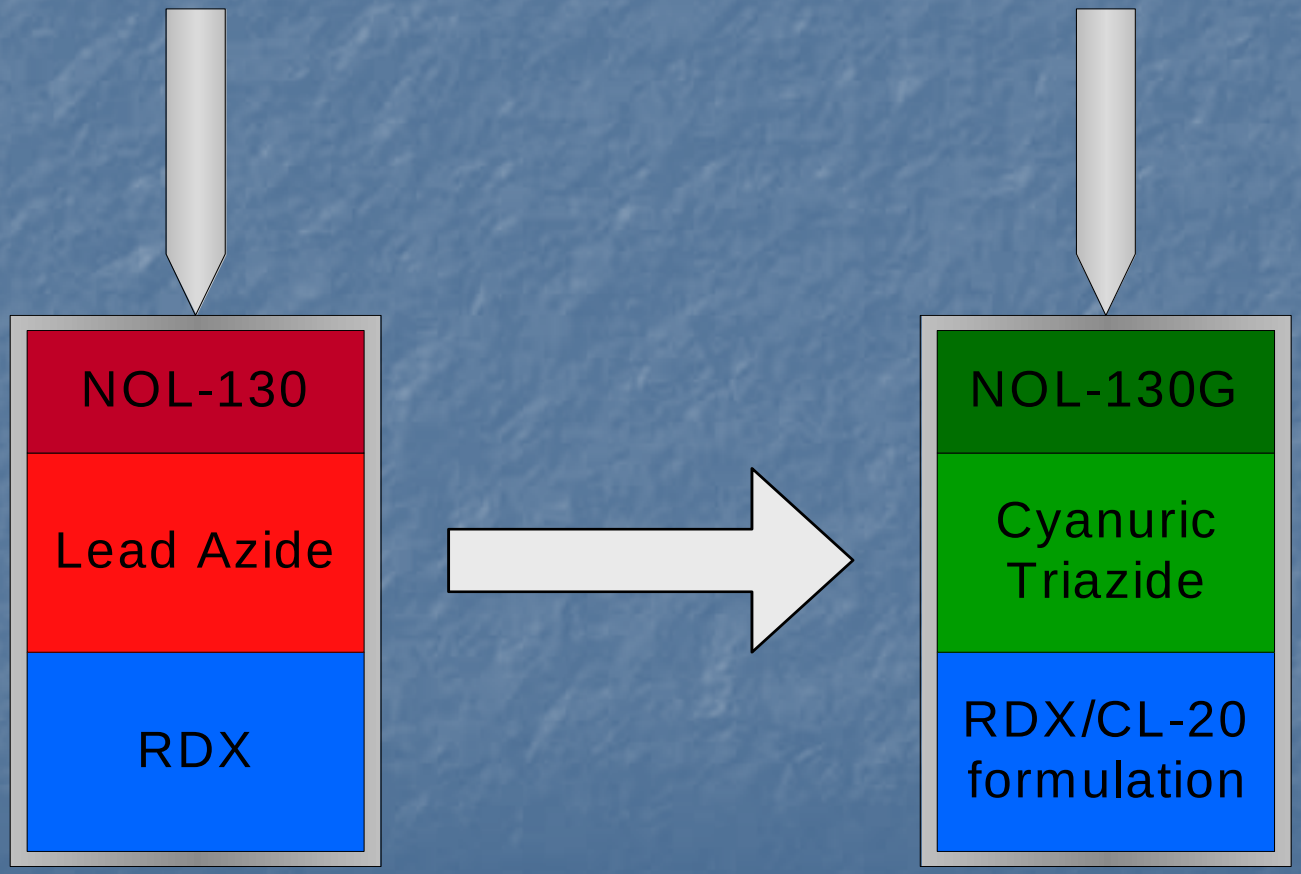
Initiator Mix Composition

NOL-130	NOL-130G
Lead Azide	Cyanuric Triazide
Lead Styphnate	
Tetracene	Tetracene
Barium Nitrate	Barium Nitrate
Antimony Trisulfide	Antimony Trisulfide

Transfer Charge Replacements

- Replacing the transfer charge will eliminate rest of the lead
  - Must be sensitive enough for detonation transfer
  - Must be powerful enough to cause high order reaction of output charge
- Cyanuric Triazide

Lead-Free Stab Detonator



Benefits

- Lead-Free Material
- Give US manufacturing capability
- Eliminates single point failure source in fuze/detonator supply chain
- Utilizes present technology for preparation and production
- Simple production process, with low waste, non-toxic

Sensitivity Tests

- Ball Drop Impact
  - LA: 7-11”
  - NOL-130: 14”
- Electrostatic
  - LA: No Go at 0.0012J
    GO at 0.0016J

- Ball Drop Impact
  - Cyanuric Triazide: 10”
  - NOL-130G : 9-14”
- Electrostatic
  - Cyanuric Triazide (as formed):

    No Go at 0.031 J (0/20)
  - Recrystallized Cyanuric Triazide:

    No Go at 0.0012 J (0/20)

Sensitivity Tests

- Small Bam Friction
  - LA: No Go at 10-20g
    GO at 30g

- Small Bam Friction
  - Cyanuric Triazide (as formed):

    No Go at 10g (0/10)

    Go at 20g
  - Recrystallized Cyanuric Triazide:

    Go at the minimum load - 10g

Detonator Ball Drop Test Setup

M55 Detonator Holder

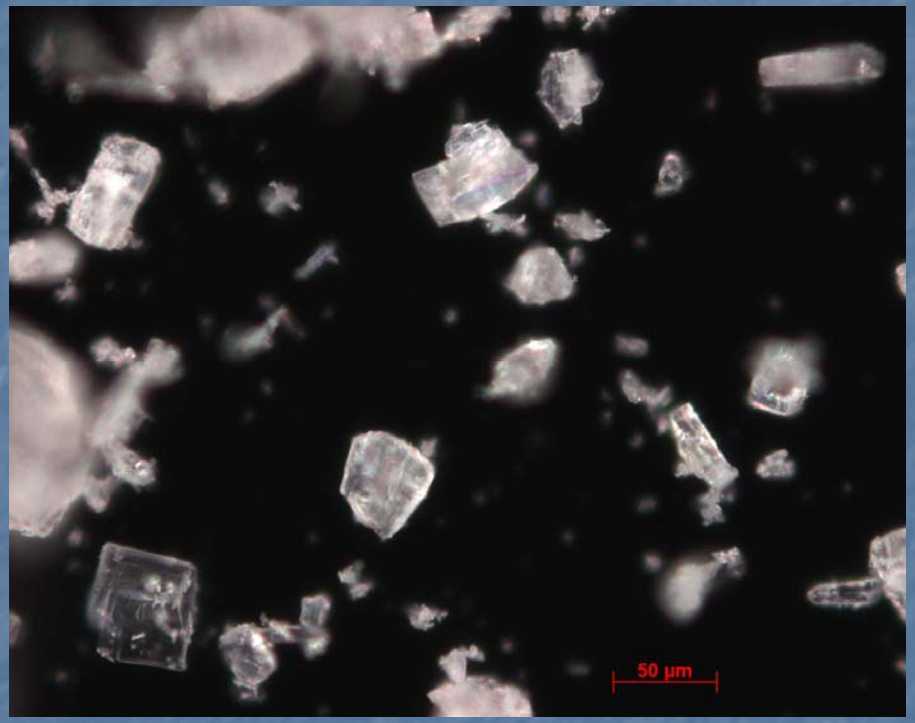
M55 Detonator – Ball Drop Test

#	NOL-130 (mg)	NOL-130G (mg)	Lead Azide (mg)	Triazide (mg)	RDX (mg)	EDF (mg)	Comments
1	15			29			GO
2	15			37			GO
3	15			20	19		GO
4	15			20		19	GO
5		15	51		12		GO
6		15		20	17		GO
7		15		20		17	GO

Witness Plates

Microscopy

As Formed



Recrystallized

Conclusions

- Developed new stab composition, NOL-130G.
- Replaced Lead Azide with Triazide.
- Investigated the replacement of the output charge with a CL-20 formulation.
- Approved to file a Patent for NOL-130G and Lead-Free Stab Detonator.

Future Work

- Optimize particle size of cyanuric triazide.
- Optimize loading of the transfer and output charges.
- Qualify Cyanuric Triazide and NOL-130G.