

# Development of a Heavy Metal-Free Electric Detonator



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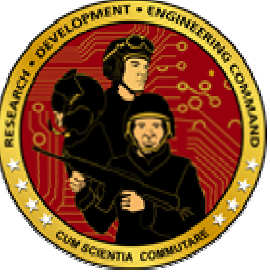
# Introduction

- Current issues with primary initiating explosives are:
  - No Lead Azide production in the US
  - Environmentally hazardous
- Initiated a program to develop new heavy metal free primary initiating explosives for the production of “green” bridgewire detonators.

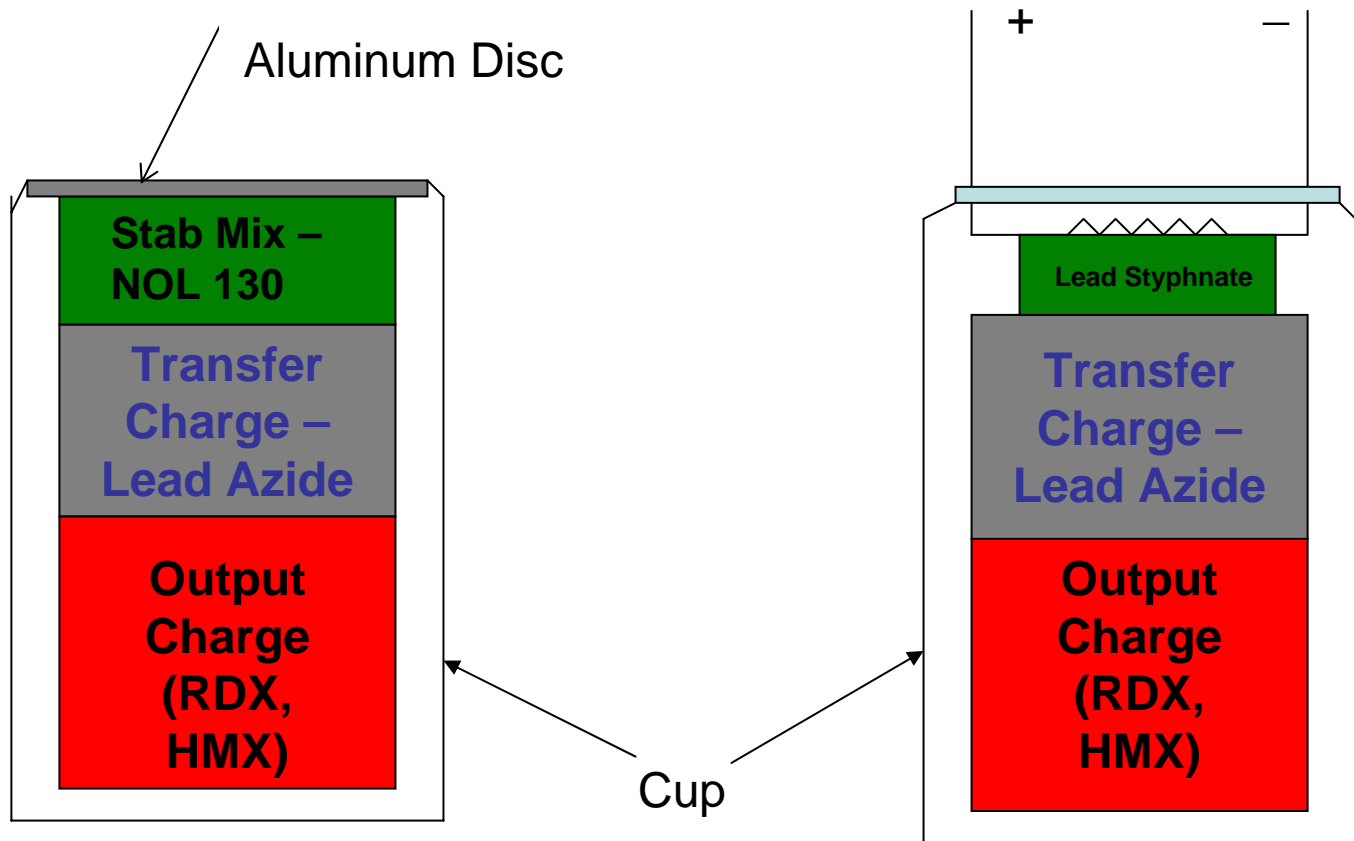


# Program Objectives

- Produce Heavy Metal-Free initiating explosives.
- Replace Heavy-Metal energetic materials in bridgewire detonator.
- Reduce soldiers', workers' and the environment's exposures to lead.

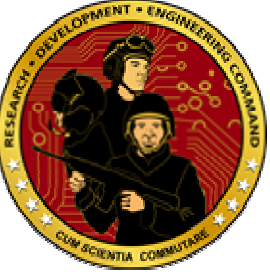


# Traditional Detonator

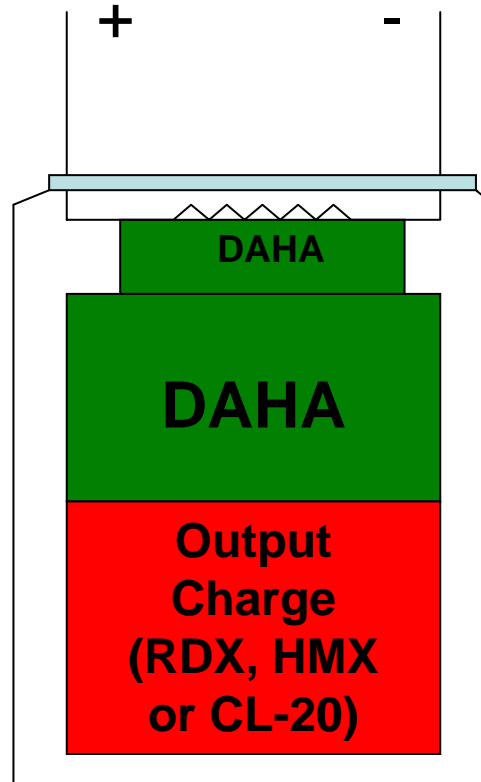


**Stab Detonator**

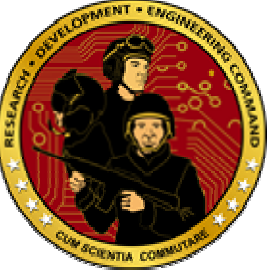
**Electric Detonator**



# Green Detonator

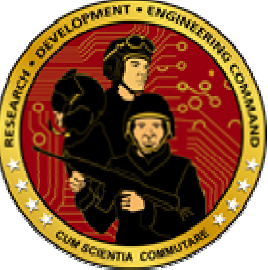


**Electric Detonator**



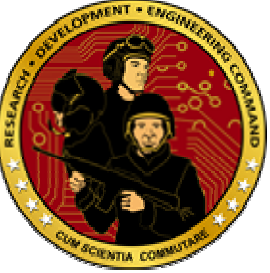
# End Items Impacted

- Detonators
  - Electric
    - MK1
    - M100
  - Stab
    - M55
    - M61

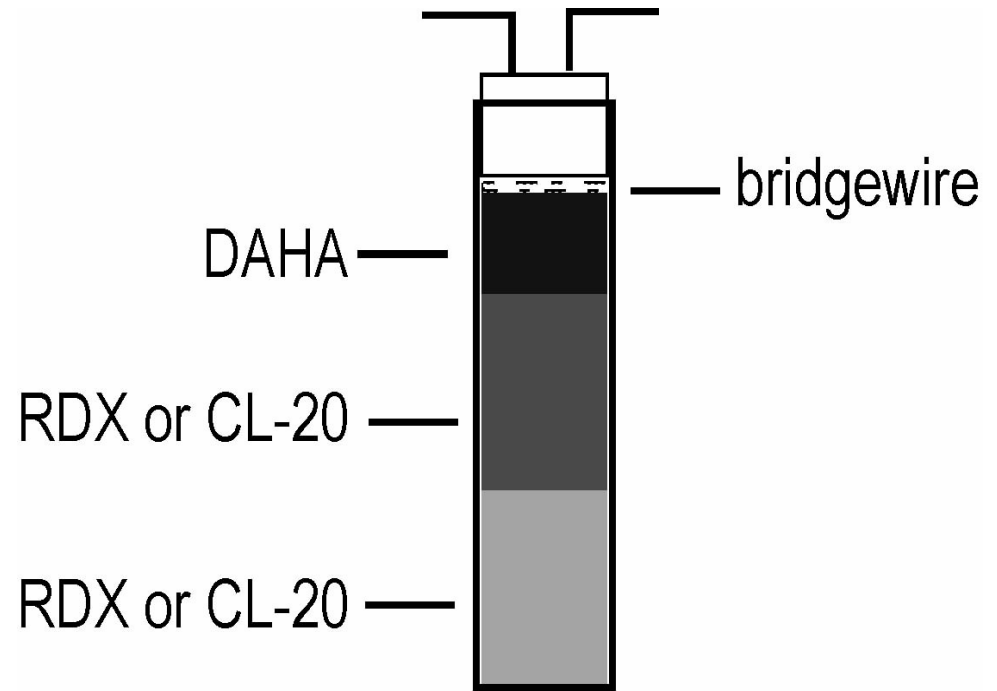
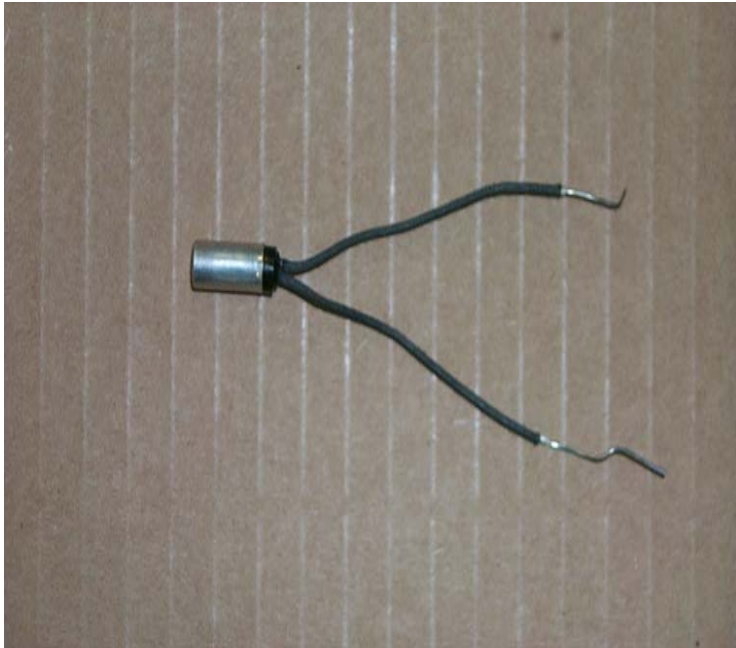


# Compounds Tested for Green Detonator

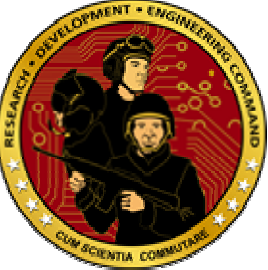
Compound	Properties	Tests	Results
DAHA	Solid	Impact Bridgewire MK1 detonator	Primary Explodes Full detonation with A-5 booster pellet
EDNAP	Solid	Impact Bridgewire MK1 detonator	Primary Burns One successful detonation
HNP	Solid	Impact Bridgewire MK1 detonator	Secondary Burns Burns
1,3-diazidoacetone DNPH	Solid	Impact Bridgewire MK1 detonator	Insensitive secondary Not tested Not tested
1,3-diazido-2,2-dinitropropane	Liquid	Impact Bridgewire MK1 detonator	Primary Flash/burn Flash/burn
tris(azidomethyl)nitromethane	Liquid	Impact Bridgewire MK1 detonator	Primary Flash/burn Not tested



# MK-1 Detonator Loading Setup







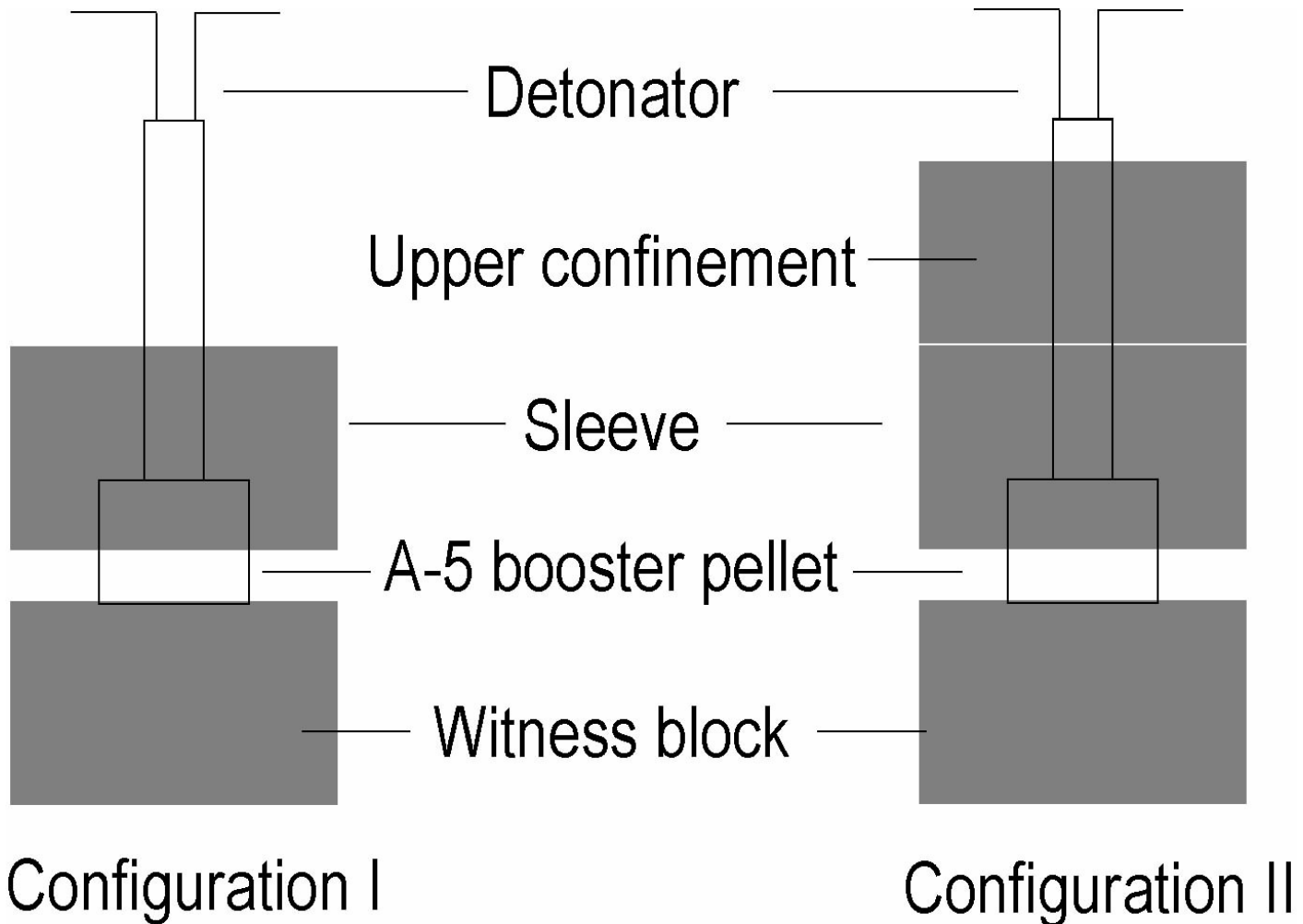
# MK-1 Detonator DAHA Testing

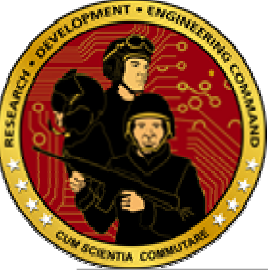


Cup #	Weight (mg)			Result
	DAHA	CL-20	RDX	
1	X	---	X	DAHA initiated. Large flash. RDX initiated. Complete detonation transition.
2	X	X	---	DAHA initiated. Larger flash than in 1. CL-20 initiated. Complete detonation transition.
3	X	---	---	Large flash and flame.
4	X	X	X	Complete detonation transition.
5	X	X	---	Cup confined, fired against Al witness plate: detonation, plate cracked.



# Test Setup





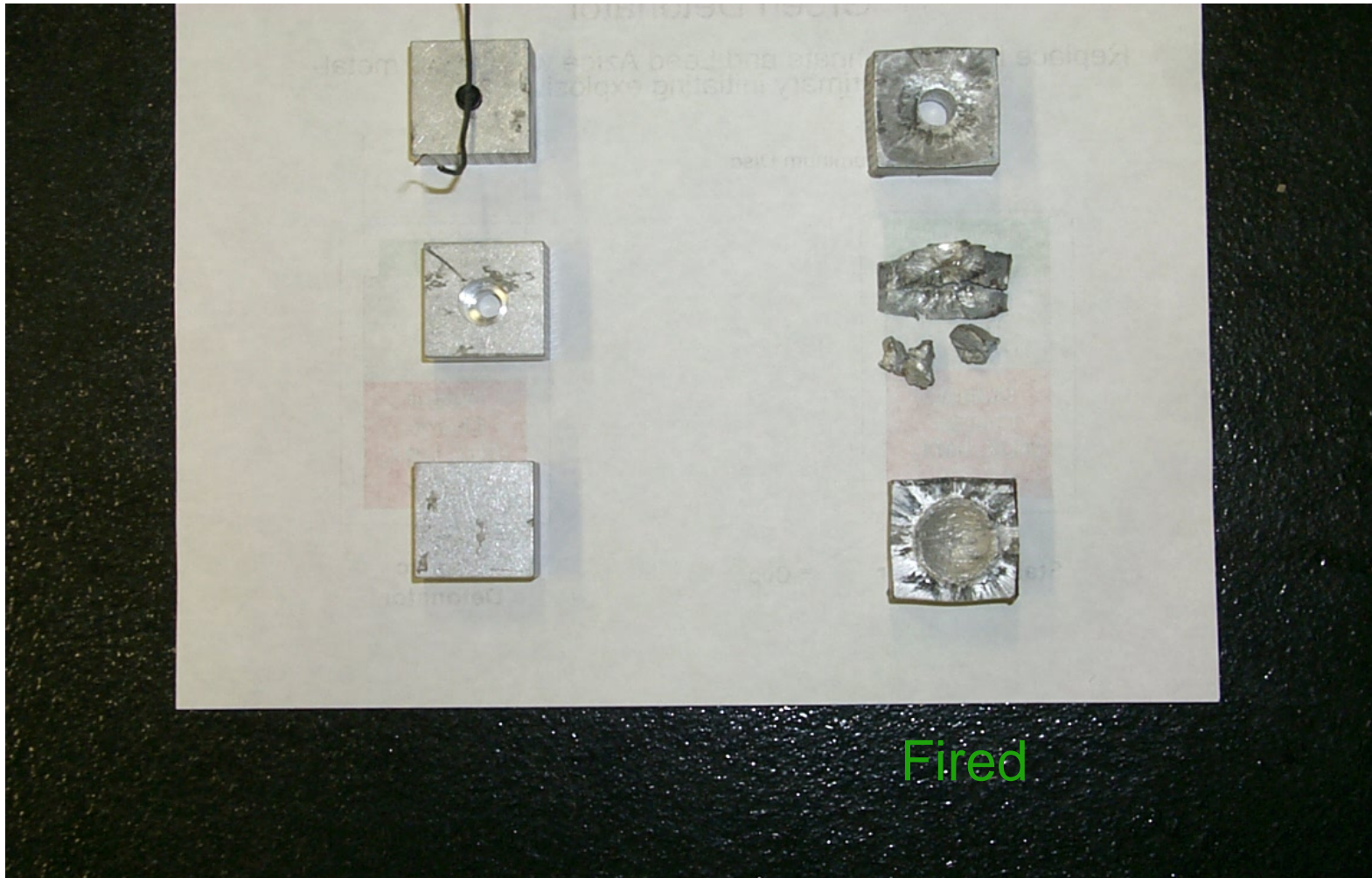
# DAHA Testing – Full Detonation Train



Cup#	Weight (mg)			Configuration	Result
	DAHA	CL-20	RDX		
1	100	800	-	I	DAHA initiated. Cup split. CL-20 still in cup.
2	150	800	-	II	Complete detonation transition. Large dent in witness plate
3	200	800	-	II	Complete detonation transition. Witness plate destroyed, only small pieces found
4	150	300	500	II	Complete detonation transition. Large dent in witness plate. Center sleeve destroyed.



# Test Blocks Fired with A-5 Booster Pellet





# Conclusions

- MK-1 detonator loaded with DAHA as the initiating explosive and RDX, CL-20 or both materials as the secondary energetics were successfully functioned.
- Successfully functioned and initiated the whole initiating train against A-5 booster pellets and complete firing train.
- Identified additional initiating materials for testing.