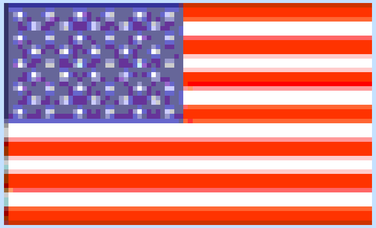

IM Fuze Design of Fuzing Systems for GUN LAUNCHED PROJECTILES

JUNGHANS Feinwerktechnik

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Prepared by:

A. Nolte & J. Fitzgerald-Smith

contact at JUNGHANS: andreas.nolte@junghans-fwt.de

Presented by:

M. Kopf

Contents

1. Background

Inherent explosive safety of munitions is dependent on fuzing systems that have safety features, that

- ensure its most sensitive component, the detonator, being out of line in the explosive train until arming
- and explosive elements below the rotor i.e. leads and boosters being no more shock sensitive then Tetryl.

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2. Fuze Explosive Train

For Fuzes in Insensitive Munitions the Explosive Components below the Shutter now become the most critical Element as:

They have to be as insensitive as the main Filling.

They have to initiate and provide effective take over onto the main Filling.

This can be achieved by:

- introducing suitable Canditate Booster Explosives and Booster design or by designing suitable packaging or mitigation techniques.

3. Design Techniques

As suitably qualified new insensitive lead and booster explosive compositions are now available for fuze designers, this paper lists these new materials and describes how Junghans as a fuze manufacturer is addressing IM design for its fuzes for gun launched munitions.

It covers the problems of:

- modifying old fuze designs by either modifying the explosive train
- delaying the fuze booster reaction
- expelling the fuze from the main charge
- venting systems on the fuze
- coping with increased critical diameter‘s of new IM main charge fillings

4. New Fuze Explosive Materials of interest

• Lead Charge	Mass	Comp.	
- Debrix 11	60mg-	RDX/Wax	99/1
- ROWANEX 3601	200mg	TATB/RDX/Bind	60/35/5
- DxP1340		Oktgen/Bind	96/4
- PBXN7		TATB/RDX/Bind	60/35/5

• Booster

- ROWANEX 3601	14gr-20gr
- DxP1340	
- PBXN7	

5. Modification of old fuze designs by modifying the explosive train.

- Artillery Fuze :

Lead Charge	Booster	Old	New
X		Tetryl	Debrix
	X	Ch6	ROWANEX3601

- Mortar Fuze :

Lead Charge	Booster	Old	New
X		Tetryl	Debrix
	X	HWC	ROWANEX3601

6. Delaying the fuze booster reaction

Such as using a lead charge which has a higher Temperature of initiation than the Booster and as well using a booster that also has a Temperature of initiation higher than the Main Charge!

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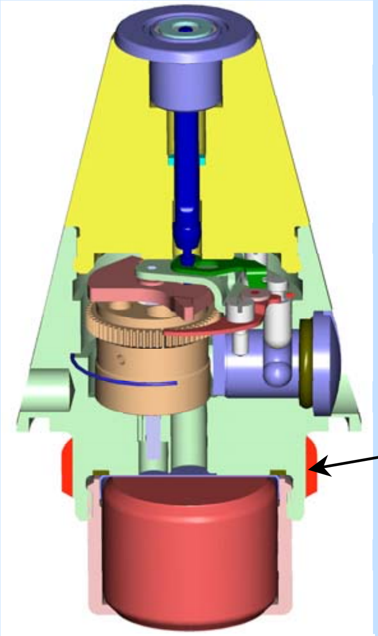
New Lead Charge		Old Lead Charge
DEBRIX 11		Tetryl
	Temperature of initiation	
216°C		185°C

7. Expelling the Fuze from the Main Charge

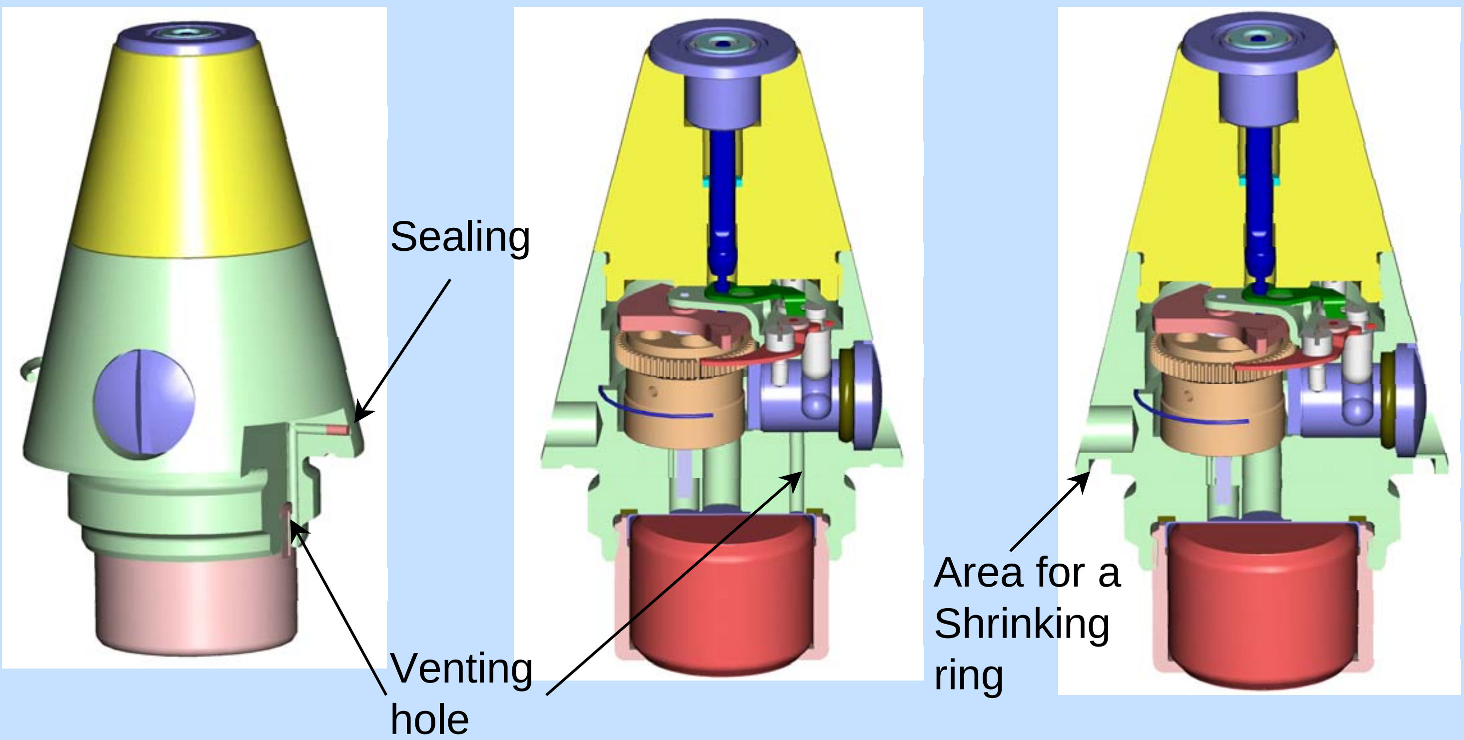
The increase of the pressure inside the munition due to external heat could lead to a reaction. To decrease the pressure the fuze must have the possibility to expell from the munition. This can be acheived by e.g. plastic threads.



8. Venting systems on the fuze

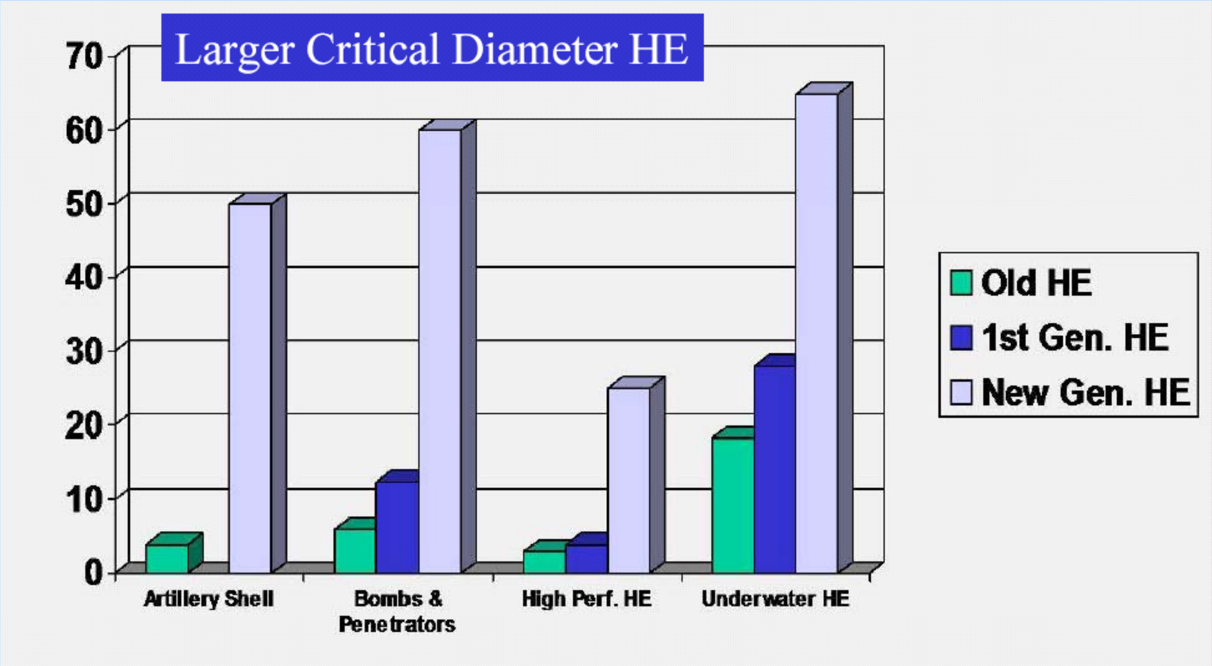
Some possible venting systems are shown for the

Mortar Fuze DM111A4 / L127A3:

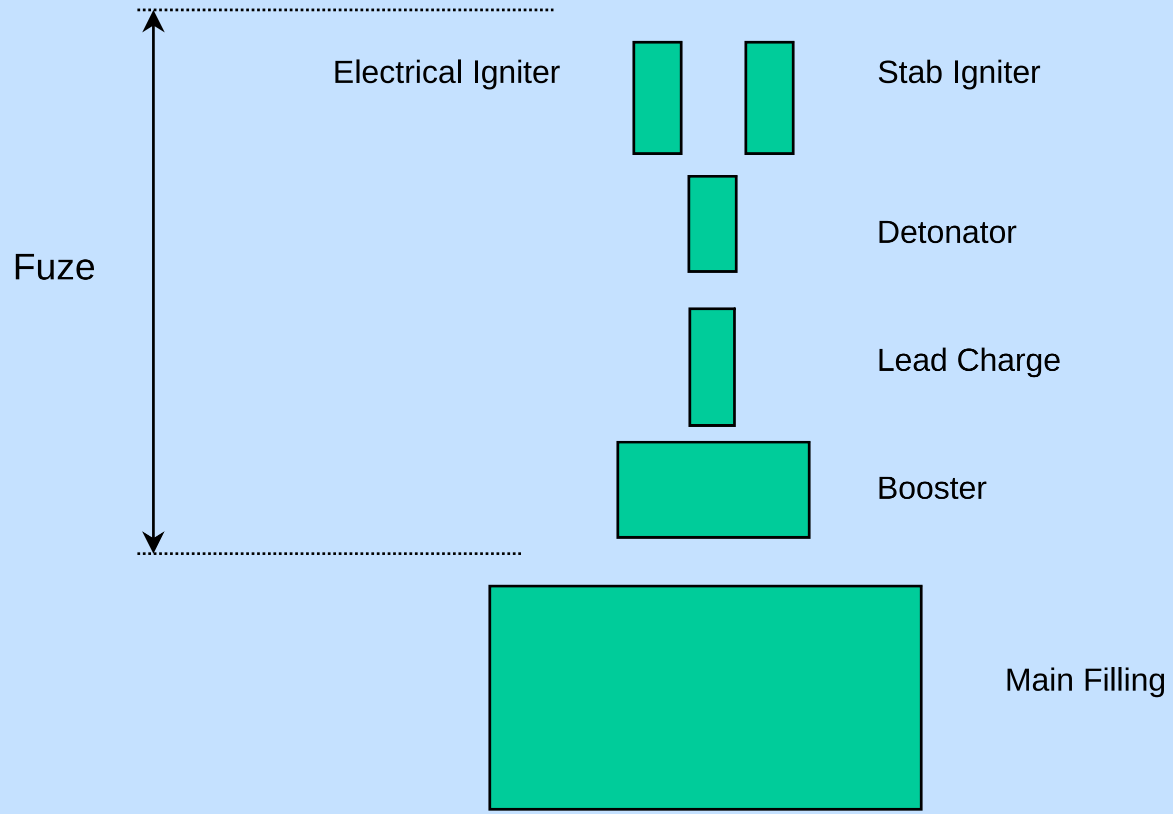


9. Critical Diameter

The critical diameter of Artillery Rounds
has changed from approximately 5mm to greater than 50mm in IM-filled rounds.

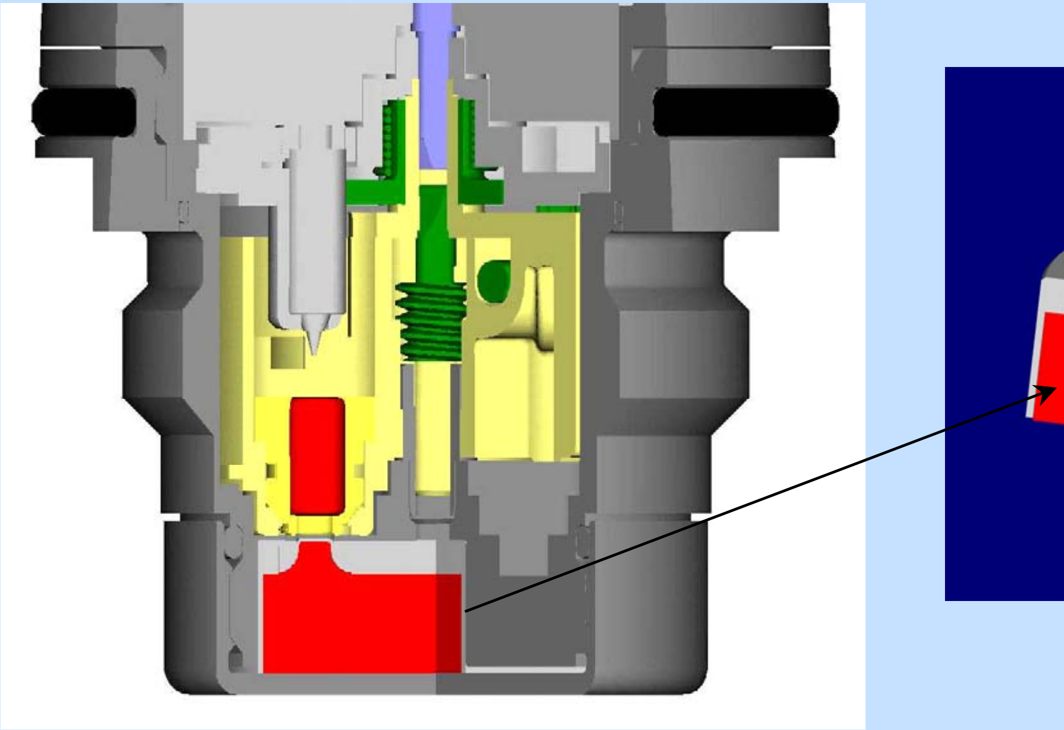


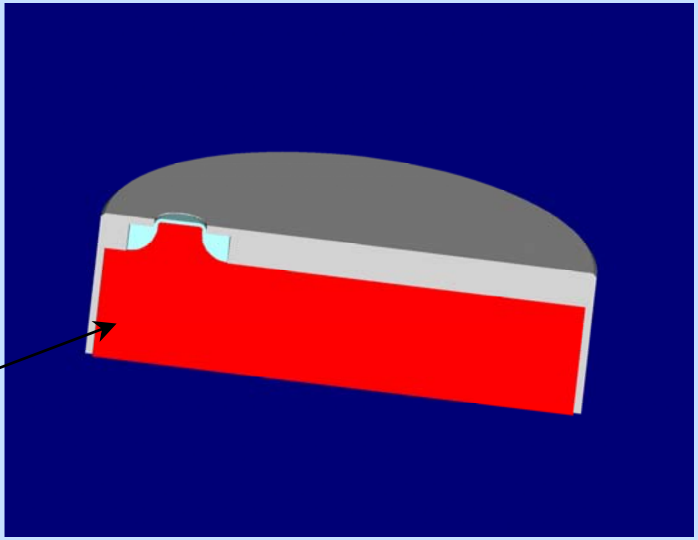
10. Firing Train of current Artillery Fuze



11. Shaping of Booster

For Fuzes with a new Design Boosters are successfully integrated with a new shape as follows.





12. IM Testing Approach for Fuzes

Since the Explosive Elements in Fuzes are of low Mass and Volume when compared to Munitions, the paper proposes a quantitative approach to assessing the explosive Output Responses that can be measured when conducting full scale tests so that a comparison can be made on assessing such items as Fuzes for there Level of IM ness.

- Blast pressure gauges at distances positioned at distances of 2 m, 5 m and 15 m
- Digital video camera
- High speed video
- 35 mm camera
- Metal witness plates
- Fragment screens
- Heat flux gauges (added for the Fast Heating Test)

13. IM Signature

13.1 Assigning types of reaction against the IM tests of small quantities of explosive stores such as fuzes demonstrated the results being

- subjective
- not scientific
- not useful for any form of risk assessment

13. IM Signature (continued)

13.2 NIMIC‘s 1997 workshop realized this issue and recommended levels of response (the distance in metres in a horizontal plane where overpressures, thermal energies and fragment projection did not exceed a set of values i.e. levels 5, 15 or 50)

13. IM Signature (continued)

13.3 Following yardsticks were set :

2nd degree burns (142 Kj/sqm)

loss of hearing (5 kPa)

no fragment projection

13.4 Using this yardstick on original IM tests conducted on an Artillery Fuze fitted with a non IM booster revealed a level 15 for fast and slow heating, a level 5 for bullet attack and sympathetic reaction and a level no greater than 50 for shaped charge jet attack. Therefore a comparison can be made using this approach for fuzes fitted with IM boosters.

14. Conclusions

14.1 Introducing new booster energetic materials with better IM characteristics has proven to be more difficult for old fuze designs than with new specific IM / system fuze designs, such as JUNGHANS IM fuze for case telescopic 40mm ammunition.

14.2 The fuze design for IM purposes can not be designed in isolation from the complete munition system.

14.3 In confirming the IM status of a fuze, it is recommended that the full scale IM tests adopt a quantitative assessment approach due to the small amounts of energetic materials present and present the results as levels of response based on a distance from the test.