



COMBAT SYSTEMS

A NEW COMMERCIAL FUZE FAMILY FULFILLING MODERN SAFETY AND RELIABILITY REQUIREMENTS FOR 40MM GRENADES

**Baltimore, 58<sup>th</sup> Fuze Conference, 7-9 July 2015**

Dr. Robert Hüttner, Head of Product Division Fuzes



# Agenda

- 1** Short Company Presentation
- 2** Background – Modern ammunition requirements
- 3** The Rheinmetall 40mm Family
- 4** Reliability and Safety
- 5** Summary and Forecast



# Business Unit Weapon & Munition

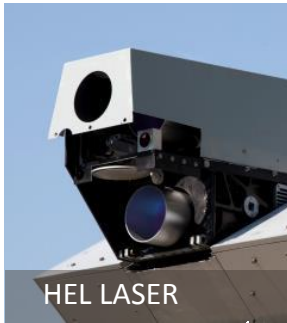


WEAPONS

AMMUNITION



155MM ARTILLERY



HEL LASER



FUZE SYSTEMS



PYROTECHNIC



40MM SYSTEMS



60MM MORTAR



120MM HE DM11



# Product Division Fuzes



Development



Production



Proving Grounds



Testing



Tank Fuzes



Shoulder launched



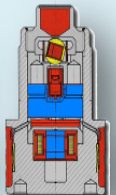
Infantry Grenades



MORTAR and Artillery



Medium Caliber





## Product Division Fuzes

- Rheinmetall Defence has increased activities in the fuze business continuously since 2007
- 5 fuze qualifications ran in the last 3 years successfully
- Rheinmetall is self funding **new** fuze projects
- Rheinmetall is investigating into potential locations for fuze development, production, and approaches for international cooperation
- **Rheinmetall's target is to become a leader in the fuze business**

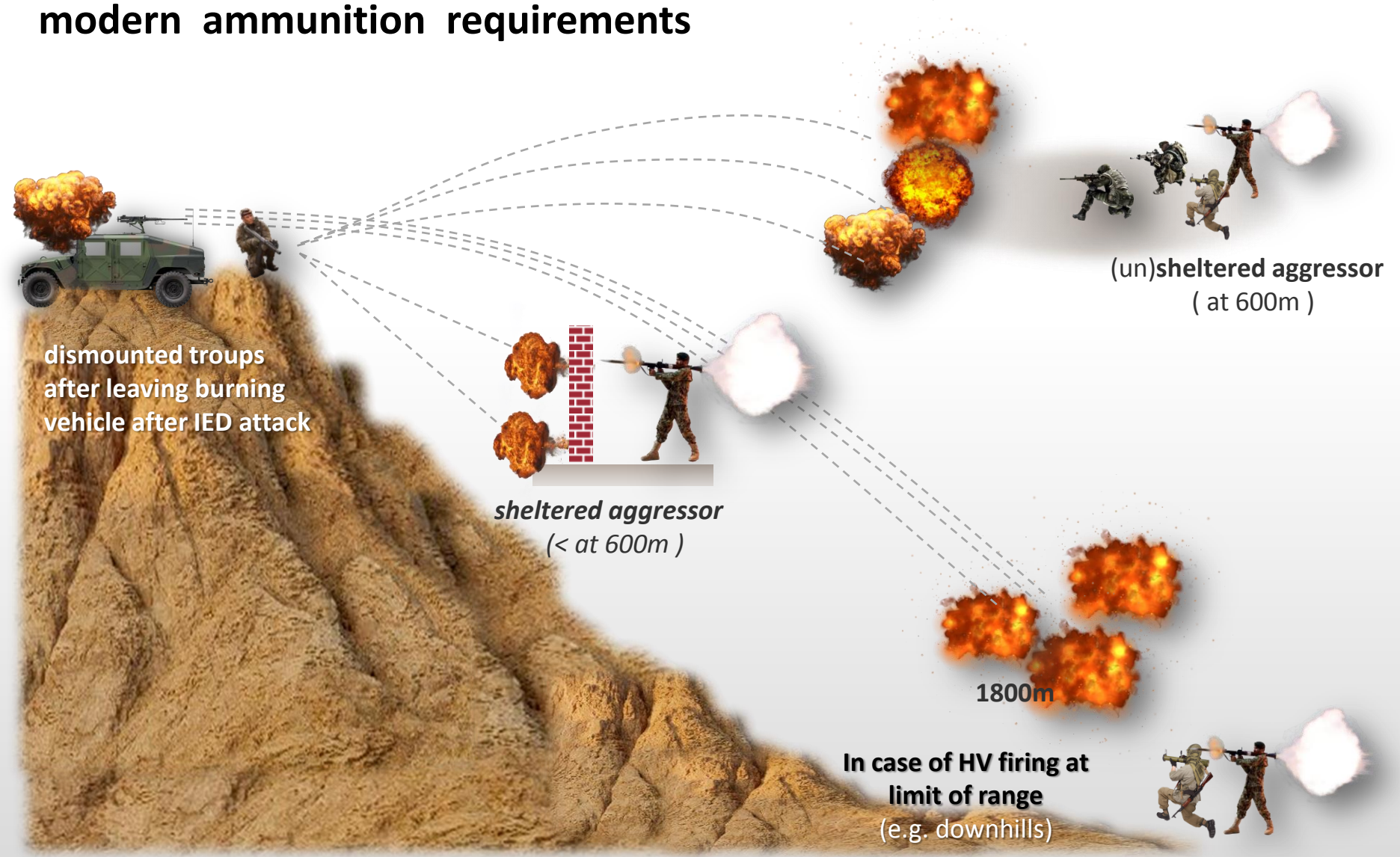


## Background – modern ammunition requirements

- Latest MOPs have shown additional ammunition requirements in the field of infantry weapons
  - The main issues are shown in the following diagram:



# Background modern ammunition requirements





## Background – modern ammunition requirements

- **Resulting is the need for:**
  - Variability in range (>> LV)
  - Variability in target effectiveness/ target engagement
  - High efficiency of ABM munition (CEP and hit probability)
  
- **Additional customer specific requirements :**
  - High requirements from customer regarding safety & functionality („Fennek test“, or high angle sensitivity)
  - High reliability (less UXO effort) reg. duds and functionality

**Rheinmetall conducted improvement programs on the 40mm family for several years**





## How did we achieve this ?

- **One key element is the self destruct (SD) feature**

▶ We have created a design with the capability to achieve the greatest possible functionality and reliability

- **Another key element is having great flexibility regarding customer requests**

▶ We have created design concepts where most design elements can be easily interchanged.



## Creating an SD function in a 40mm fuze

### Pyro-delay element:

- Reliability issue at high temps -
- difficult to achieve long times (>30s) -

### Mechanical:

- Issue of extremely dangerous duds ! -

### Electronically:

- can be completely discharged +
- highly reliable +
- long delay time +
- Requires electrical energy -
- enables other features +

- **Mechanical impact** (percussion detonator)
- **Electrical self destruct** (electrical detonator) → up to 33s delay time
- **Enables new functions if energy problem is solved**





## Technical Data Range

**With this modular SAD system we cover the full range of fuze applications (LV-HV) – „One size fits all“ !**

LV Systems	Muzzle velocity :	$V_0 =$	78m/s
		range	<b>400m</b>
	max. acceleration:	$a =$	6.000g
		max. spin: $D =$	3.800 Upm
LR (LV+)	Muzzle velocity :	$V_0 =$	100m/s
		range	<b>650m</b>
	max. acceleration:	$a =$	12.000g
		max. spin: $D =$	4.950 Upm
MV Systems	Muzzle velocity :	$V_0 =$	135m/s
		range	<b>800m</b>
	max. acceleration:	$a =$	25.000g
		max. spin: $D =$	6.700 Upm (under development)
HV Systems	Muzzle velocity :	$V_0 =$	245m/s
		range	<b>&gt;2000 m</b>
	max. acceleration :	$a =$	55.000g
		max. <b>spin</b> : $D =$	12.500Upm



## Example: Technical data HV

<b>New HV concept:</b>	Point Detonating Fuze with Electric Self-Destruct
<b>Arming:</b>	Setback $\sim 550,000\text{m/s}^2$ , Spin $\sim 12.400\text{min}^{-1}$
<b>Muzzle Safety:</b>	No arm 18m, All arm 40m, mechanical safe and arm device
<b>EI. Self-Destruct:</b>	electronic Time $\sim 33\text{s}$ or spin drop below $4.000\text{min}^{-1}$
<b>Reliability:</b>	PD-Function 98% and due to SD-function the dud rate is less than 0.7%
<b>Compliance: Requirements</b>	Full compliance with STANAG 4187 „Fuzing–Safety Design“
<b>Energy supply:</b>	Setback generator (qualified by German Armed Forces)



Enhanced / extension of functionality → Airburst function!

→ **qualified in Germany in 2014**

Adaptation to MV

→ **currently under testing**

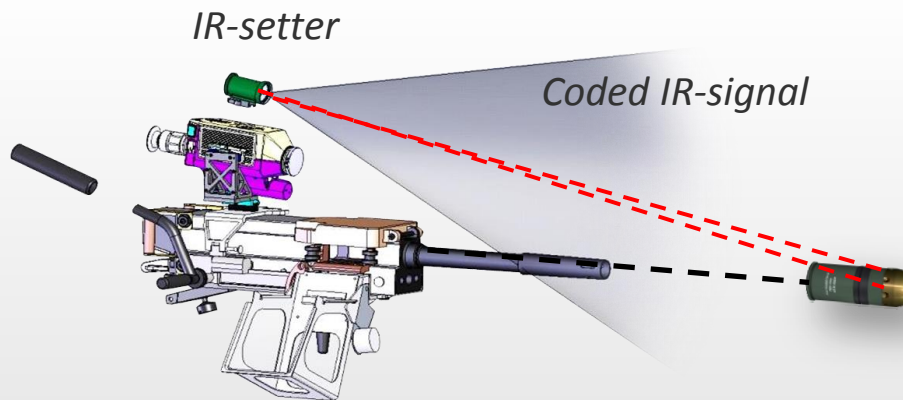
## 40mm x 53 Fuse family – HV options – PD and ABM

The modular design of the fuzes uses different housings (with or without diodes) and different PCBs only:

### PD versions



### ABM version



*Fuze in-flight programming*

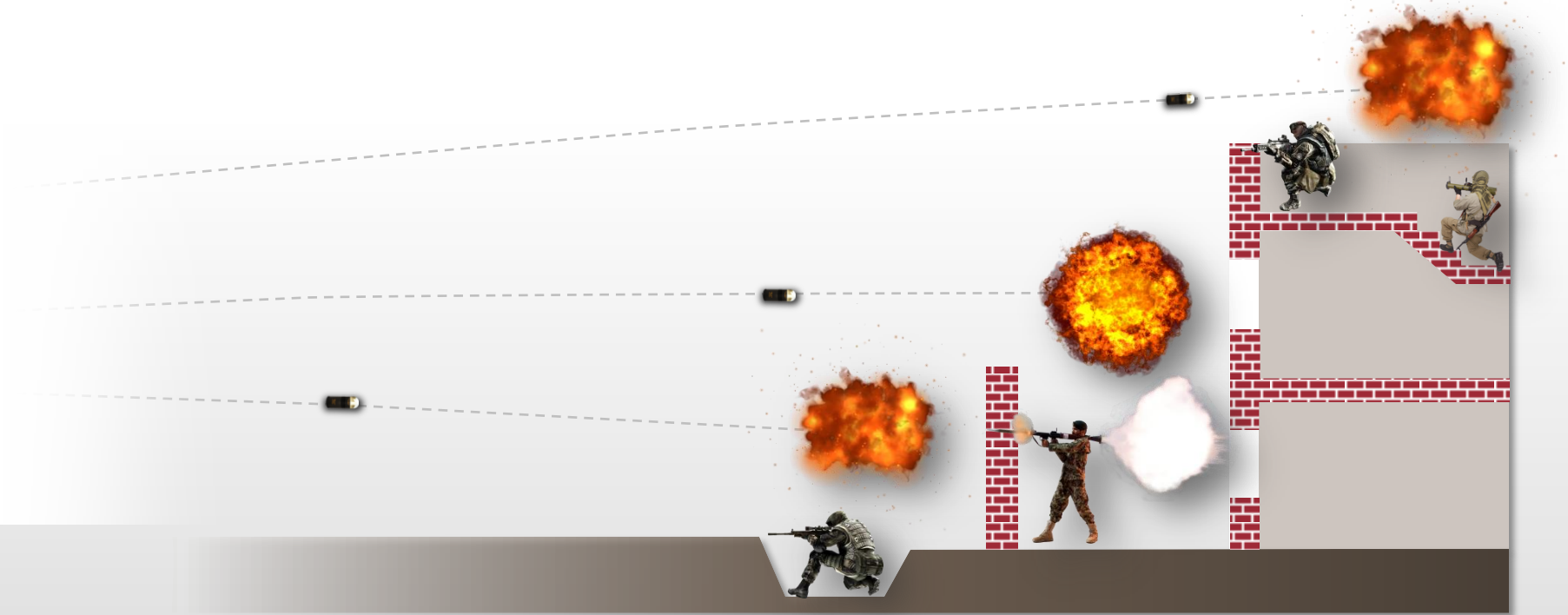


RWM 40mm Concept:

## ABM is the highest performing effector

Airburst infantry ammunition's most obvious advantage is effectiveness

against targets behind shelters, – which cannot be reached by classical ammunition



***But there are more benefit !***

*This schematic is property of the Rheinmetall Defence AG*

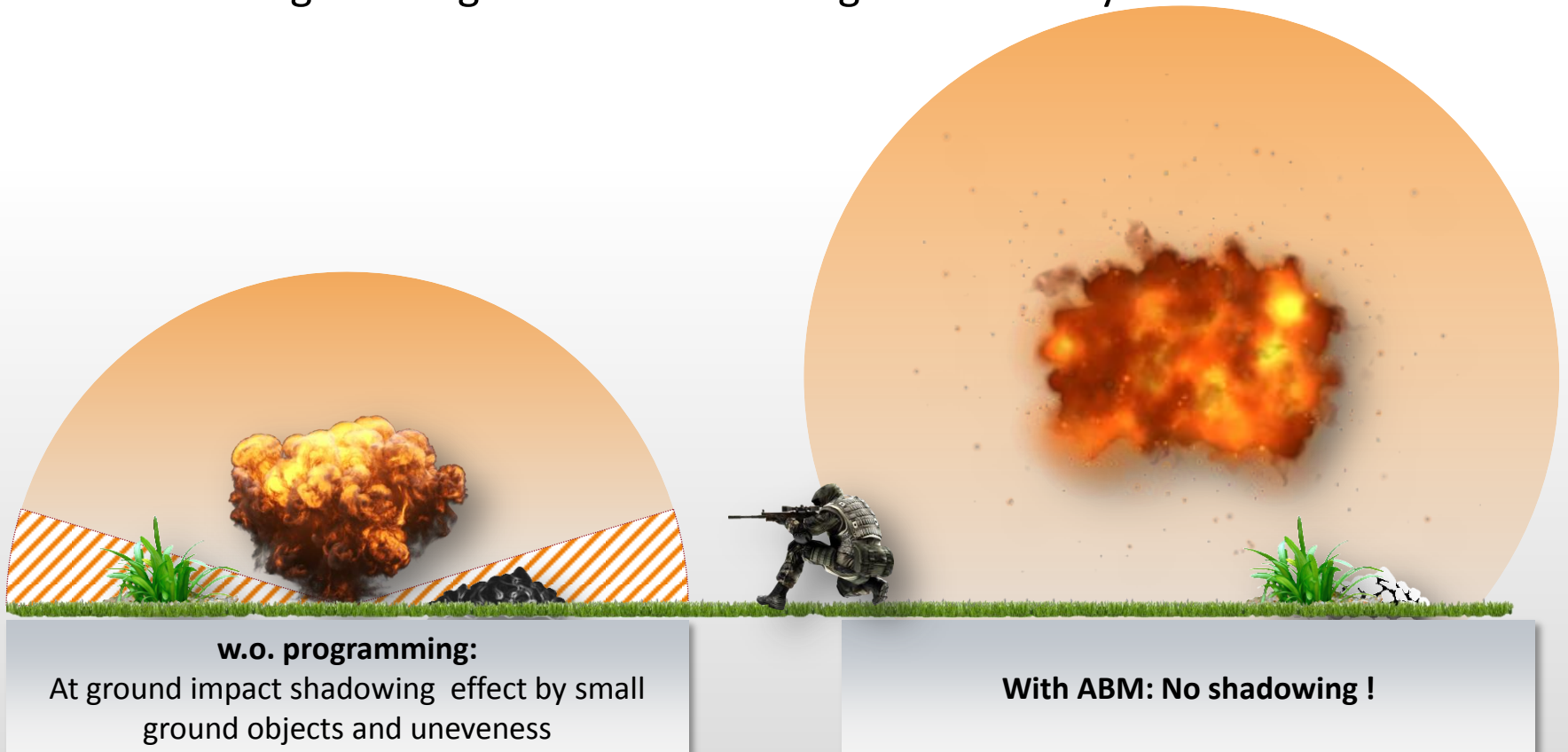


RWM 40mm Concept:

**ABM is the highest performing effector**

**Benefit of air burst ammunition versus PD-ammunition:**

- No shadowing due to ground effects → higher efficiency



*This schematic is property of the Rheinmetall Defence AG*

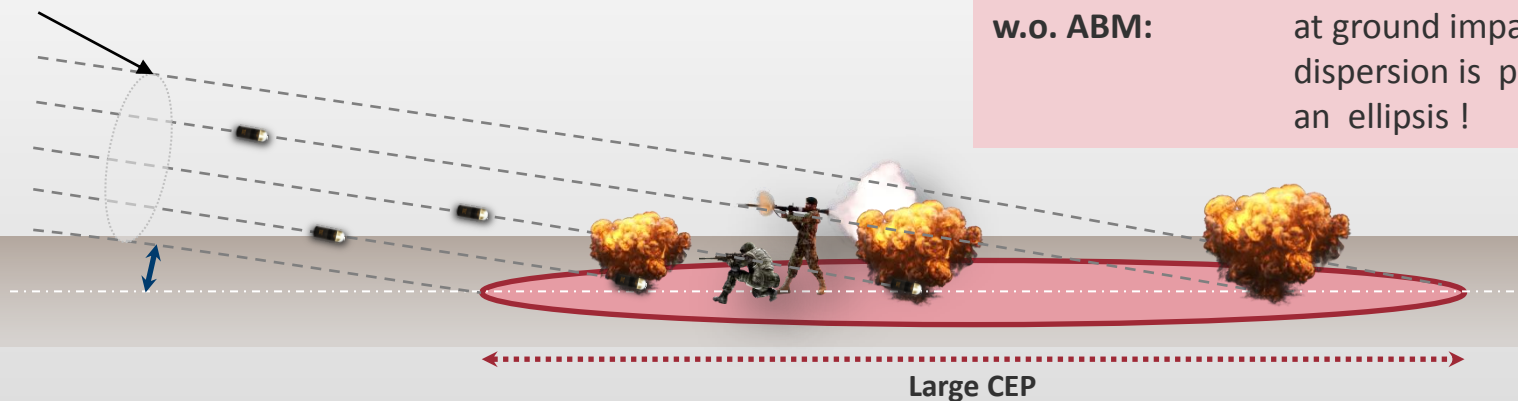
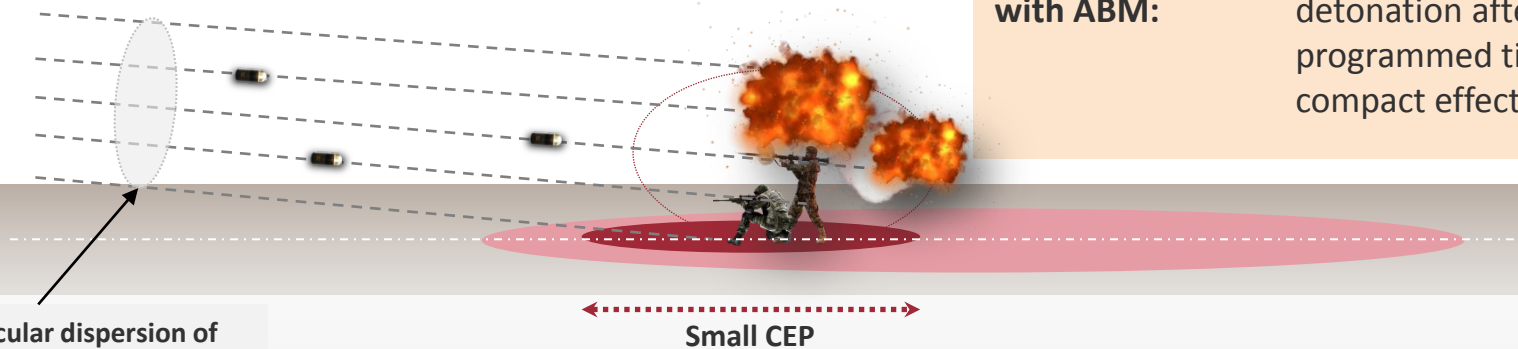




# ABM capability offers higher efficiency by reduced CEP !

## Benefit of air burst ammunition to PD-ammunition:

- Higher precision, higher effect, less logistical burden !

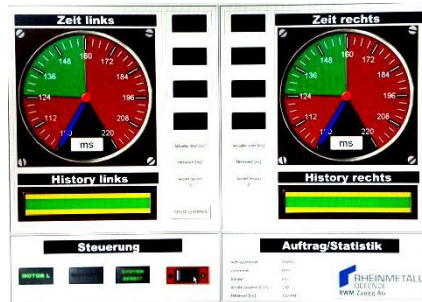


*This schematic is property of the Rheinmetall Defence AG*

## Reliability & Safety: Production Quality

- Quality assured by 100% control of critical parts
- Arming time is measured, stored and documented for each fuze in production
- Very stable process (about 4-Sigma distance from USL & LSL), additional reliability is achieved by selection
- Swiss watchmaking technology and engineering

→ *>98% reliability and less then 0.7% dud rate*





# Reliability & Safety: Simulated transport

<b>Airplane</b>	„Propeller Aircraft“ / annex C1 $F_0 = 68 \text{ Hz}$ (4 blades) Per axis: 120 minutes
<b>Helicopter</b>	„Helicopter Cargo“ / annex D1 $f_1 = 11,25 \text{ Hz}$ (main rotor / CH-47D Chinook) Per axis: 120 minutes

**Ship 1** „Shipborne Vibration Test Description“ / annex E1  
„Surface Ships, minesweeper size and above“  
Upper deck, Protected compartments, Hull“  
Per axis: 120 minutes

**Ship 2** „Shipborne Vibration Test Description“ / annex E1  
„Surface Ships, small than minesweeper size“  
„Mast heads, Upper decks, Protected compartments, Hull, General Tests“  
Per axis: 120 minutes

**Train:** Railroad Cargo Test Description“ / annex E1  
Per axis: 120 minutes

**Wheeled Vehicle** DAF YA 4442 [9b]  
Per axis: 120 minutes

**Wheeled Vehicle** „Tactical Wheeled Vehicle – All Terrain“ / annex A2  
Per axis: 367 minutes

**tracked Vehicle** „Heavy Vehicle – Material on Spnson or installed in Hull“ / annex B3  
Per axis: 154 minutes

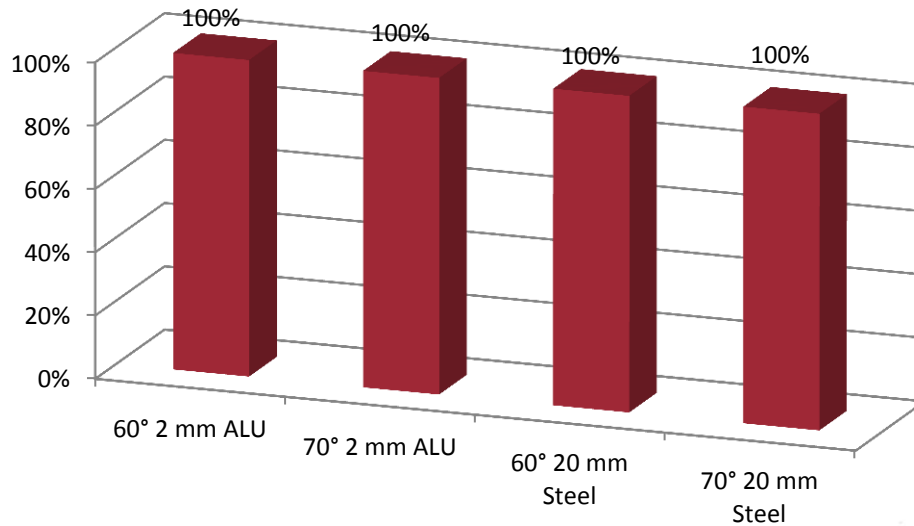
**History: Past failure at qualification for USMC  
due to strong vibration requirements:**

**Special care in the design, specific material  
selection and quality procedure enable the  
Rheinmetall fuzes to fulfil specific customer  
requirements like increased and harder vibration  
loads**

(Here: NL vibration requirements including  
helicopter noise)



## Reliability & Safety: High low angle sensitivity



*Test results on angle sensitivity on different material*

**Full fuze performance is achievable up until very high impact angles,**

**Even at 70° Nato angle :  
100% functionality achieved!**

*( @ 2mm Alu plate and 20 mm steel plate!)*

**Our Fuze design performs at specifically high customer requirements for slanted angle sensitivity !**



# Conclusion

Rheinmetal Defence offers a highly modern, efficient and reliable Infantry systems for HV, LV and MV

New fuze functions like airburst capability allow high effectiveness, high efficiency and less logistical burden due to munition saving

**Systems are fielded/in charge:** Nato qualified systems available for LV and HV since 2013:

- Customer PE HEDP: DM471: GER (ABM: 2014)
- Customer PE HE: DM461: GER (PD: 2015)
- Customer : Canada, Qualific. (2011)
- Customer: NL, Qualific., (2013)
- Customer: Austria (2013)
- Customer: Denmark (2013)
- Customer: Italy (2014)

System for MV currently under testing

Specific customer requests can be easily realized by modular fuze concepts





## Rheinmetall offers full 40mm portfolio

→ *Rheinmetall is your system provider  
for 40 mm solutions!*



## Point of Contact

Dr. Robert Huettner  
Rheinmetall Waffe Munition GmbH  
Heinrich-Ehrhardt-Straße 2  
D-29345 Unterlues

+49 5827 80-6923

[robert.huettner@rheinmetall.com](mailto:robert.huettner@rheinmetall.com)



RHEINMETALL COMBAT SYSTEMS –  
THANK YOU FOR YOUR ATTENTION