

Rheinmetall Waffe Munition



Insensitive Ammunition for the Artillery

Dr. Paul Wanninger

155 mm Artillery Charges





HE Charges Properties



	Melt cast	Cast PBX	Pressed PBX
Melting point	Melting 70 – 80°C	Decomposition ~ 180°C	Decomposition ~ 180°C
Mechanical Properties			
Tensile strength Elongation	300 [N/mm²] -	0,5 - 2 [N/mm²] 10 – 20[%]	10 – 50 [N/mm²] 1 – 2 [%]
Young's modulus	> 1000 [N/mm ²]	10 – 15 [N/mm²]	200 – 800 [N/mm²]
Coeffizient of Thermal expansion	10 ⁻⁵ [K ¹]	10 ⁻⁴ [K ¹]	5 • 10⁻⁵ [K⁻¹]
Shock sensitivity Gap Test (21 mm)	10 – 16 [Kbar]	30 – 60 [Kbar]	17 – 26 [Kbar]

HE Charges Properties



	Melt cast	Cast PBX	Pressed PBX
Raw materials	TNT, RDX HMX, NTO	RDX, HMX, … + Polymersystem	RDX, HMX + Thermoplaste
Process	Melting	Mixing under Vacuum	HE + Binder + Solvent
	Casting Controlled	Vacuum	➢ Granules ➢ Dosing ➢ Proceing
	Shrinking 11 % of the volume	Polyaddition	>2000 – 2500 bar
TMD	98 %	99,5 %	97 – 98 %
Density gradient	High	No	Yes, Depending
Vulnerability	High	Very low	Middle
Homogeneity	Low	High	Middle
Temperature resistent	No	Yes	Yes

Wanninger/Folien/Insensitive Ammunition for the Artillery

IHE



Formulation	<u>Process</u>
Binder Plasticiser	Batch + +
Bonding agent Antioxidans Catalyst	Bicomponent H +
Metal powder High explosive	Extrusion +

e.g. RDX, HMX 2 or 3 different grain sizes

Curing agent

RDX



Influence of crystal shape Included air Included solvent Impurities (grit) Use of I-RDX

Rheology Flow Curve at 50°C



RHEINMETALL

Processability

To decrease viscosity

- Grain size distribution
- Spherical grains
- Coated grains
- Non polar surfaces





Ammunition 155 mm HE – RH 30





IHE GAP-Test





Ammunition 155 mm HE – RH 30



Ammunition 155 mm RH 40 – Extended Range



155 mm HE - Rh 30 – Wall Penetration



Concrete Wall 60°

Penetration

155 mm Rh 30 with Charge Rh 26 -> X-Ray

After firing at – 46°C Tube L52



Vulnerability Tests





Wanninger/Folien/Insensitive Ammunition for the Artillery

Ammunition 155 mm HE – RH 30







Bullet Impact





155 mm HE – RH 30





Bullet Impact





155 mm Rh 40-IHE Bullet Attack Trial Set





155 mm Rh 40-IHE Bullet Attack Trial Set





Wanninger/Folien/Insensitive Ammunition for the Artillery

155 mm Rh 40-IHE Bullet Attack





155 mm Rh 40 Shaped Charge Impact Test





155 mm Rh 40-IHE and Fuze Shaped Charge Jet Impact, Trial Set





Bomblett DM 1383

155 mm Rh 40-IHE and Fuze Shaped Charge Jet Impact





Sympathetik – Detonation Test nach US MIL STD 2105 B





Sympathetik – Detonation Test nach US MIL STD 2105 B





Performance / Vulnerability 155 mm Ammunition





Mechanical Properties



Wanninger/Folien/Insensitive Ammunition for the Artillery





Wanninger/Folien/Insensitive Ammunition for the Artillery

120 mm Mortar on Wiesel





The Problem





The Team



The Initiative

- The Project started in autumn 2002 with the formation of the MONARC Project Group
- HDW: The biggest German shipyard
- KMW: Europe's leading system contractor for armoured vehicles
- <u>RWM:</u> One of the world's most innovative suppliers for ground forces equipment





Rheinmetall Waffe Munition GmbH



Project Development



Demonstration of feasibility

In December 2002 the turret of the PzH 2000 was demonstrated on board the frigate F124 class "HAMBURG" at the shipyard of HDW





In summer 2003 measurements of forces and accelerations showed the quality of the concept of elastic mounting and provided the baseline for the production of shock mounts for the integration of MONARC on any other practical type of ship

Wanninger/Folien/Insensitive Ammunition for the Artillery

Summary



The Charge Rh 26®

- Plastic Bonded, HTPB based
- 90 % of Solid, RDX based
- High Initiation Level
- High Performance
- Good Relation between Performance and Insensitivity
- Specially designed for Tank and Artillery ammunition