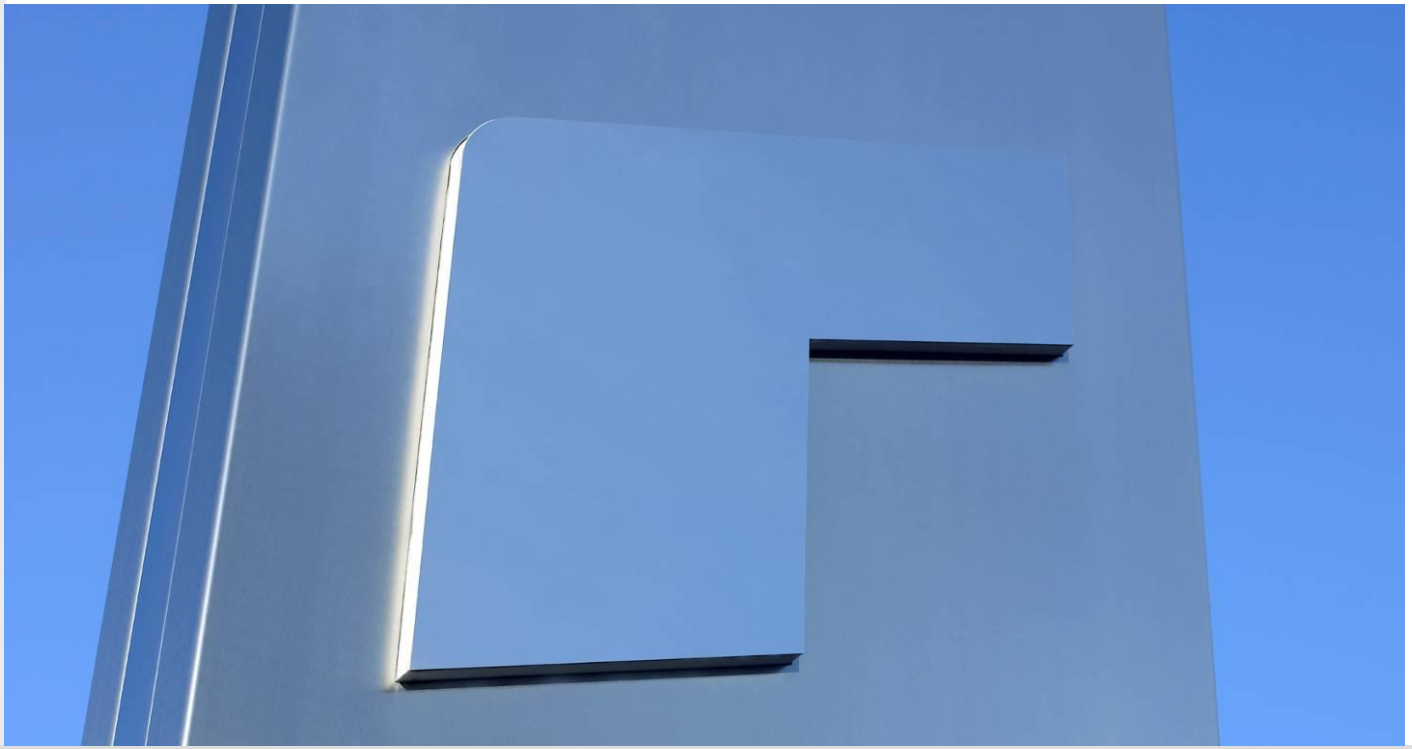


Naval Forces Capabilities Gap Against Swarm Attacks

RHEINMETALL DEFENCE

Swarm Scenario

Ten radially inbound small craft traveling at 40 knots over calm seas which have survived the outer layer of defense are to be prevented from closing to within 1000 yards of the ship.

The threat can occur during either day or night. The 10 craft are distributed inside a 90-degree arc and a 300-yard range band.

The baseline target is a “cigarette boat” which is 12m long, has a 2.6m beam

AND NOW ADD THE UAV SWARM SCENARIO

Defeat of Swarming Attacks

a Time Management Calculation

Elements of the calculation:

1. Maximum Effective Gun Range (Vr = Mach)
2. *Fire Power = Projectile Mass x Rate of Fire*
3. *Target Vulnerability Kp, Kf, Km*
4. *Rounds / Threat for Mission Kill (Km)*
   Km = Kp / Kf / Kmob (2 of 3)
5. Threat Closing Rate (Tr) – Own Ship Retirement Rate (OSr)
6. Number of Threats
7. Ready service rounds on mount

Defeat of Swarming Attacks is a Time Management Calculation

Max Eff Range – Keep out range (1000m) = Time Available
Tr (~20m/s) – OS speed*

Time available ÷ # of threats = Engagement time /Threat

*** Assuming a single ship engagement against a swarm attack, own ship would gain engagement time by setting a course away from the threat. However, this would require that the gun is mounted aft.**

Calculating for Fire Control System latency

A Gun Fire Control System (GFCS) capable of acquireing, tracking and calculating 3D target tracked data is assumed.

Based on FCS characteristics available for modern systems in the market and practical experience it is assumed that ≤ 5 seconds is the interval within which the following sequence can take replace:

- **Change target angle to new target bearing**
- **Target acquisition and entry into target tracked state and output of 3D target vector state estimation**
- **Computation of gun aim point prediction commanded angles and output to gun mount**
- **Gun mount alignment to commanded angles-the gun mount slews to the target bearing**
- **Open fire for selected burst length (dependent on gun performance).**

FIAC Vulnerability

The FIAC target is assessed for firepower personnel and mobility kill using a Boghammar RL-130, shown above.

Kf - Firepower kill is defined as damage sufficient enough such that the target cannot fire its weapons.

Km - Mobility kill is defined as damage that will cause the target to lose its ability to move in a controlled manner.

Kp - Personnel kill is defined as wounds sufficient enough such that the crew no longer functions.

Test Results utilizing a 30-mm × 173 ABM KETF round at 1500yds. This round is designed to defeat a wide range of ground, air, and marine targets by the release of a subprojectile payload just ahead of the target. The projectile contains 162 tungsten cylindrical subprojectiles each weighing 1.24 grams

Casualty Assessment Results Utilizing 5 rounds for each profile

Side Profile

The KETF round achieved a P-Kill on the FIAC crew.

The KETF round achieved an F-Kill and an M-Kill on the FIAC target.

Front Profile

The KETF round achieved a P-Kill on the FIAC crew and an F-Kill on the FIAC.

The KETF round did not achieve an M-Kill on the FIAC (front profile) target.

35 mm x 228 ABM-KETF vs 30 mm ABM-KETF

35mm vs 30mm payload = 2.5 times the # of SP

Difference between both types is the payload;

Same subprojectile dimensions

Max Eff Range: 35mm has a >50% increase

35mm = 4400m

30mm = 2900m

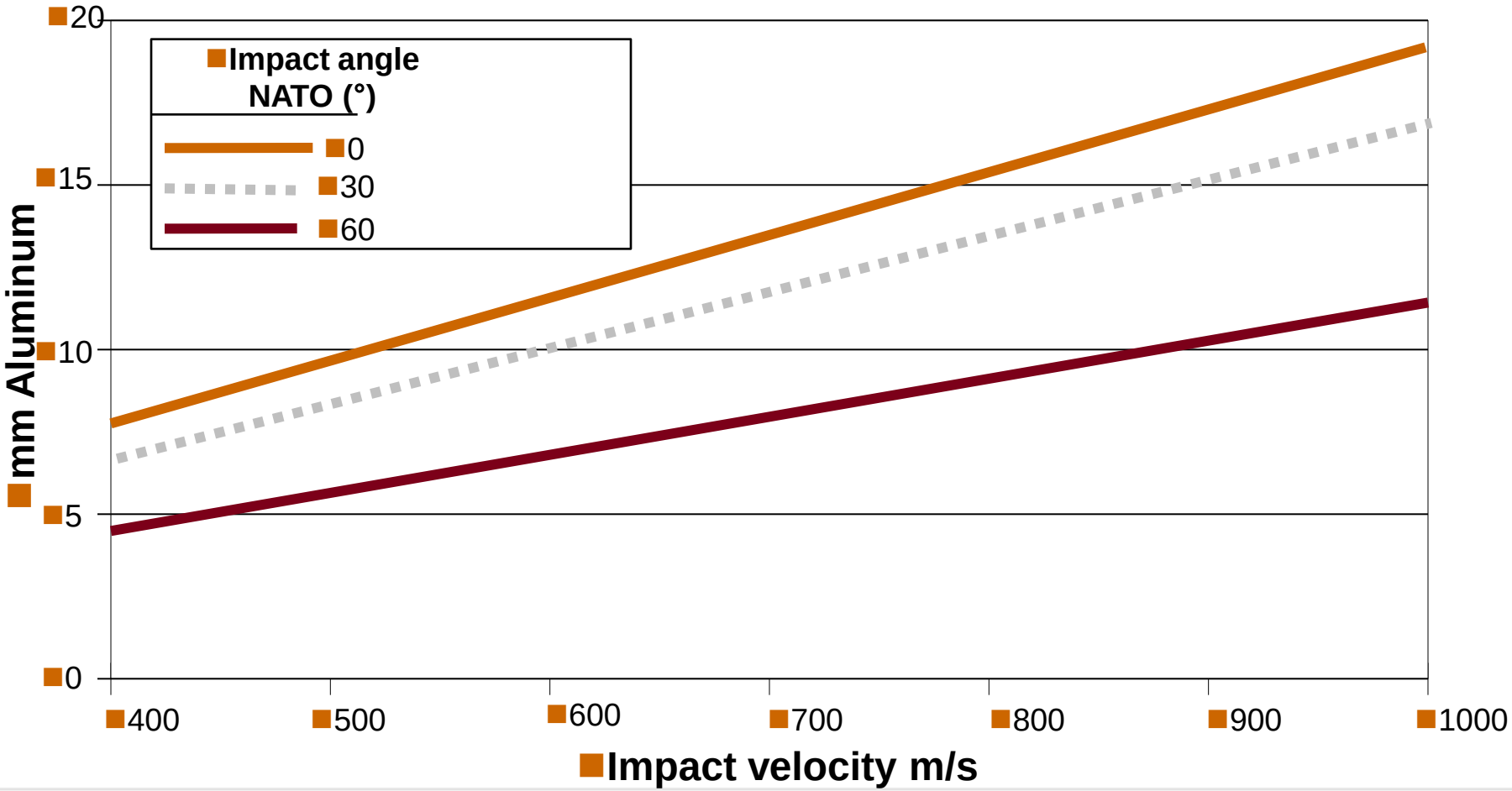
35mm payload = 407 subprojectiles of 1.24g ea.

30mm payload = 162 subprojectiles of 1.24g ea.

35 mm x 228 ABM-KETF

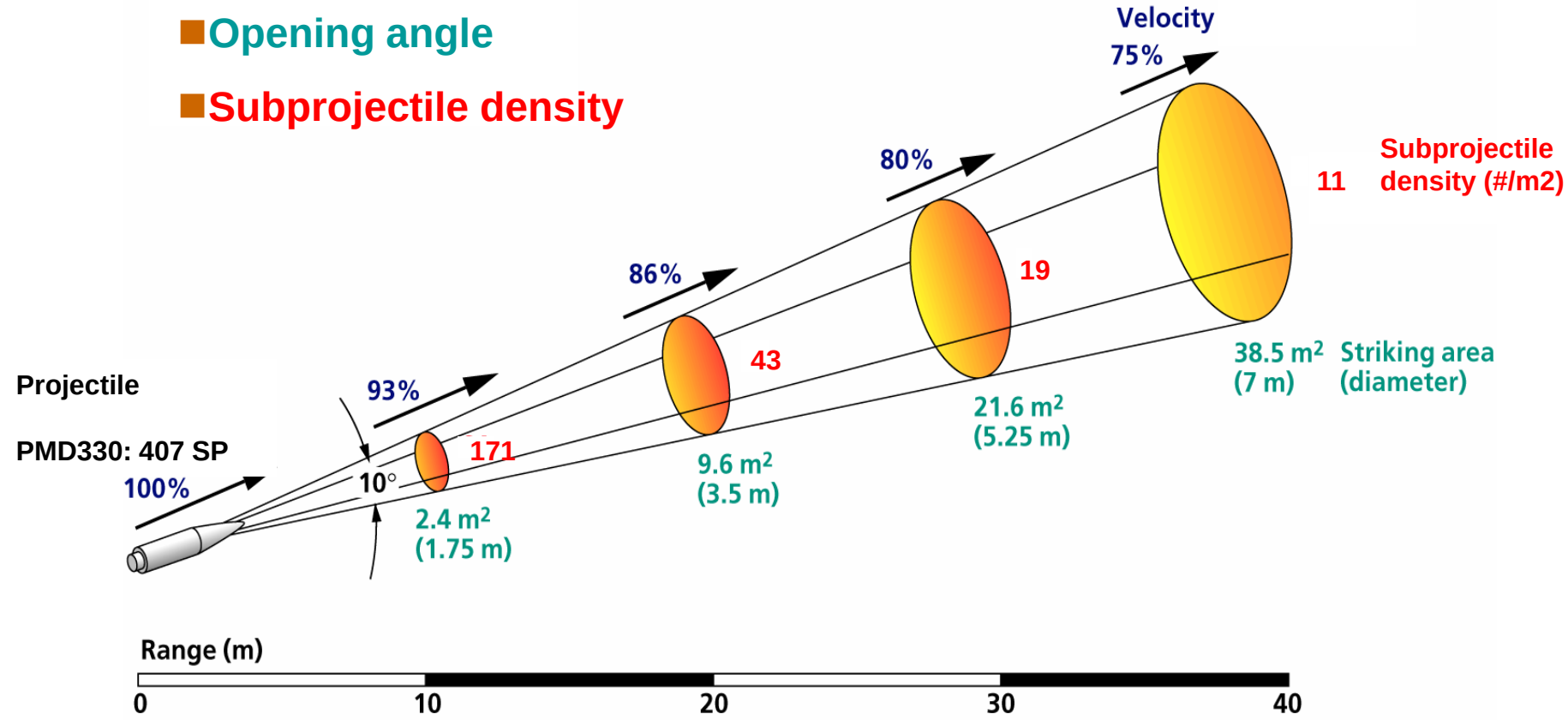
Penetration in Aluminum as a function of impact velocity and angle:

PMD330 Sub-projectiles **Mass: 1.24 gr**

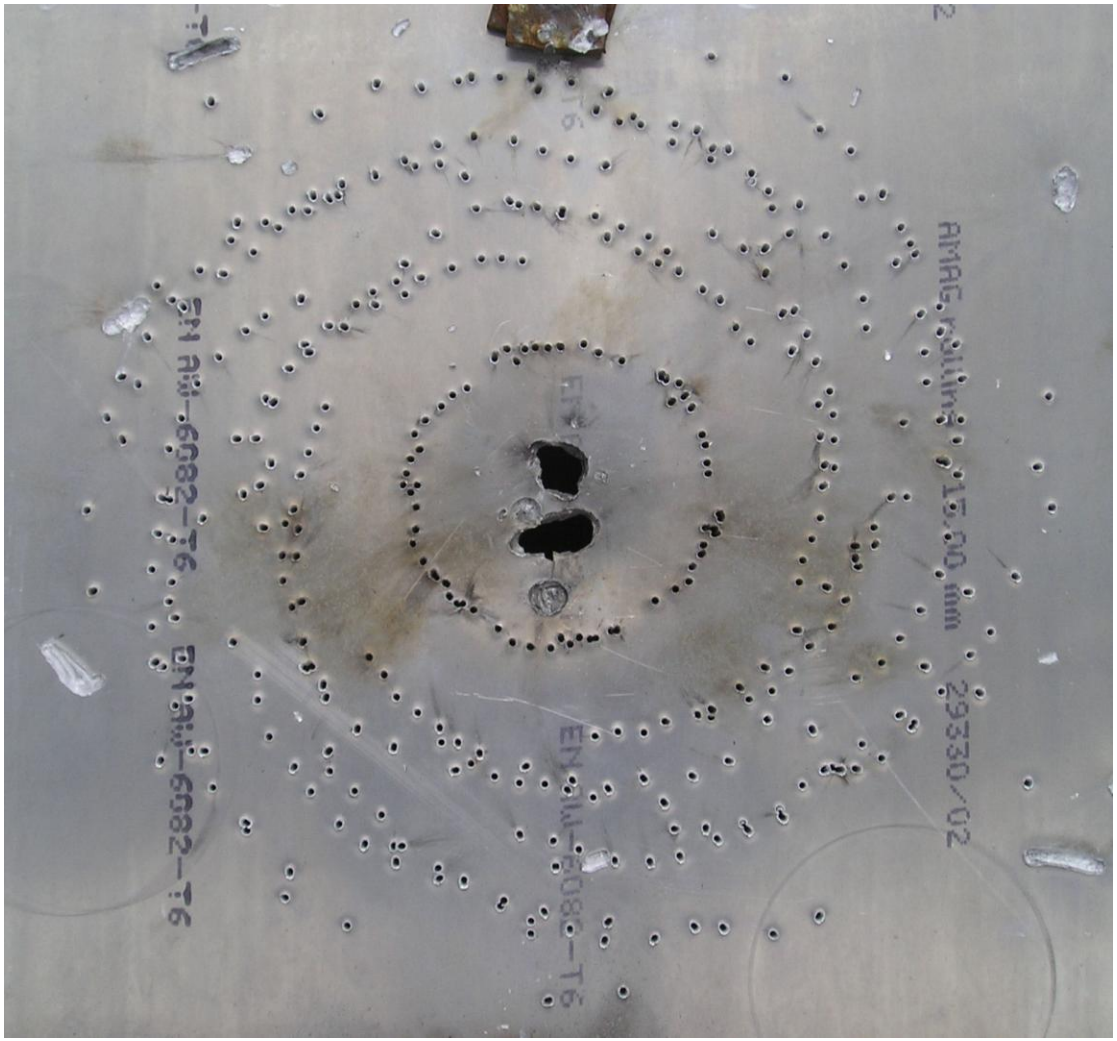


35 mm x 228 ABM-KETF

- Subprojectile Dynamic Parameter at Muzzle of PMD330:
  - Velocity decay
  - Opening angle
  - Subprojectile density



35 mm x 228 ABM-KETF subprojectile impact pattern



35 mm x 228 ABM-KETF Fire Power vs 30mm

35mm Revolver Cannon: 500 gm x 1000 r.p.m = 500 kg/min

30mm Mk.44 Cannon: 200 gm x 200 r.p.m = 40 kg/min

35mm Revolver cannon has 8 time the fire power of the 30mm

35 mm x 228 ABM-KETF Defeat of Swarming Attacks

Max Eff Range (4400m) – Keep out range (1000m) = Time Available (170s)
Tr (20m/s) – OS speed*

Time available (170s) = Engagement time /Threat (17s)
# of threats (10)

Engagement time (17s) – Fire Control time (5s) = Burst length / Threat (12s)

35mm rate of fire in seconds = 1000 rpm ÷ 60 sec = ~16 rounds/sec

30mm rate of fire in seconds = 200 rpm ÷ 60 sec = 3.3 rounds/sec

Based on test results of 30mm ABM-KETF wherein 5 rounds resulted in Mission Kill

The 35mm ABM-KETF ensures a Mission Kill thru 250% > payload and 5 X the required Rounds.

35 mm vs 30 mm Defeat of Swarming Attacks

35mm Max Eff Range (4400m) – Keep out range (1000m) = Time Available (170s)
Tr (20m/s) – OS speed*

30mm Max Eff Range (3200m) – Keep out range (1000m) = Time Available (110s)
Tr (20m/s) – OS speed*

Time available = Engagement time /Threat = 17s for 35mm and 11s for 30mm
# of threats (10)

Engagement time – Fire Control time (5s) = Burst length / Threat = 12s & 6s

35mm rate of fire in seconds = 1000 rpm ÷ 60 sec = ~16 rounds/sec

30mm rate of fire in seconds = 200 rpm ÷ 60 sec = 3.3 rounds/sec.

35 mm x 228 ABM-KETF Fire Power
vs
Full Caliber 30mm PDF

Shots Required for 90% Kill Probability						
GUN (Rate of Fire)	**1000m**	**2000m**	**2500m**	**3000m**	**3500m**	**4000m**
MK 46 30 mm (200)	17	60		135	*	*
MG 35mm Revolver (1000)	2	6	9	13	22	30
Stowed Kills - Engagements Before Reload (90% Pk)						
RANGE		**2000m**	**2500m**	**3000m**	**3500m**	**4000m**
MK46 30 mm (400 ready service) ***Max Eff Rg 3200 m***		7		3	*	*
MG 35 mm Revolver (252) ***Max Eff Rg 4400 m***		33	26	16	13	7

■ * *Beyond effective range*

Additional Effectiveness Metrics
35 mm x 228 ABM-KETF vs 30mm HE Ammo & Cannon

- incorporates muzzle velocity correction that reduces dispersion in range by 400%.
- elevation range from -15° to +75°

QUESTIONS?

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