

ANALYSIS of RUSSIAN ORESHNIK IRBM PENETRATORS

By Anthony Shell. December 2024

Photometric analysis of the video of ORESHNIK penetrator impacts (DNIPRO, 21/11/24) – of the ‘shutter-induced streaking artifact’ – gives another way of estimating impact velocities. It is widely held that ‘shutter’ speed is half the FPS: 0.025s for 20 FPS. On this basis – and a measured ‘streak’ length of 116m, this gives an impact velocity of 4.6 Km/s – i.e. within 10% of the previous, posted estimate (of 4.2 Km/s). This also provides another proof that the video was originally recorded at 20 FPS – then super-sampled at 50 FPS, giving a ‘slow-motion’ portrayal of the event.

Penetrator impact energy = thermal energy + kinetic energy; where:

thermal energy = heat capacity per Kg (at terminal temp) x penetrator mass (Kg)

kinetic energy = mass (Kg)/2 x (terminal velocity)²

Each of 36 penetrators delivers to a (sub-surface?) target some 220 MJ of KINETIC ENERGY + 77 MJ of THERMAL ENERGY – with each 25 Kg penetrator built from HAFNIUM CARBIDE (or equivalent).¹ Ground impact at 4.2 Km/s (Mach 12). Re-entry is 6.81 Km/s – however 3.77 Km/s is removed from potential 7.97 Km/s ground impact by atmospheric drag – resulting in penetrator heating to 4000 C. The 297 MJ is equivalent to 71 Kg TNT. Therefore, each of the 6 salvoes is equivalent to 426 Kg TNT (same as for one US Mark 84 900 Kg bomb).

Estimated penetrator dimensions: length = 100cm; diameter = 5cm.

Estimated penetrator weight = 25Kg (for Hafnium Carbide construction, or equivalent).

Estimated penetration depth = 10 m of reinforced concrete, or 100 m of soil.

Note that such weapons systems are designed to a particular form of requirement, often dictated by the current or perceived emergent threat – and often expressed in ‘rounded’ parameters.² The requirement (in this case) will drive the design solution toward a low penetrator cross-section to length ratio; a very high (hypersonic) penetrator velocity; and, therefore, the high energy density – to achieve damage to a particular range of (deep) sub-surface targets.³ It is believed that up to 6 separate targets, spread over many kilometers, can be targeted by each ORESHNIK. There is, at the moment, no credible defence to this type of attack within exist within the US/NATO arsenal.

¹ A possible alternative that would fit the requirements would be TANTALIUM CARBIDE

² For example, a requirement for an anti-tank weapon will be to penetrate 100mm of case-hardened steel armour – not to penetrate 85.4mm or 113.3mm of armour!

³ Re. (for example) data as per ‘Hypersonic Kinetic Penetrator Projects’, GlobalSecurity.org, 3rd December 2019

