A Composite Sabot Technique to Launch 120-mm APFSDS Projectiles from a 7” HARP Cannon

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For the last several years, the U.S. Army Research Laboratory (ARL) has been conducting a terminal ballistic research program investigating extending rod technology in the ordnance and hyper-velocity regimes. The launchers used in this effort are 120-mm cannons of various lengths and 7” HARP cannons (High Altitude Research Program). The launcher is selected by the projectile mass and desired impact velocity. However, situations arise where using a longer cannon or a larger bore do not provide the most desirable projectile for a specific penetrator/velocity configuration, requiring innovative sabot solutions.

When selecting a launcher for a particular set of experiments, two limiting design parameters related to the penetrator are the inertial loads from axial acceleration and the parasitic mass of the sabot. The inertial loads of high aspect-ratio penetrators are carried by the double-ramp sabot which also fills the bore of the cannon, determining the parasitic mass. Research projectiles are usually made of aluminum, but if circumstances require, GRP (graphite reinforced plastic) sabots can be used in 120-mm cannons to decrease sabot mass to attain higher velocities. If the desired velocity cannot be attained with a GRP sabot in extended length 120-mm cannons, or the axial accelerations are too high in the high pressure 120-mm cannons, the much larger and lower pressure HARP guns are used. Here, aluminum sabots must be used because GRP sabot material is not large enough to fill the bore. The larger bore of the gun adds significant mass to the sabot’s bore riding structures, and if the penetrator mass is small, the relatively heavy sabot petals can disturb penetrator flight at discard.

To reduce sabot mass in these cases, a technique has been developed to ‘retrofit’ a 120-mm sabot to a 7” HARP gun by adding a plastic carrier to the sabot as illustrated in Figure 1. This carrier must serve two roles: fill the bore while supporting the sabot; and remain attached to the sabot through sabot separation and discard. This functionally graded, composite sabot provides the necessary strength to carry the penetrator’s inertial loads and transitions to a commercially available, light-weight material at the larger radii, reducing overall mass significantly. An added benefit of this approach is that standard 120-mm projectile components can now be used in larger bore guns when circumstances warrant and reduce both manufacturing time and costs.

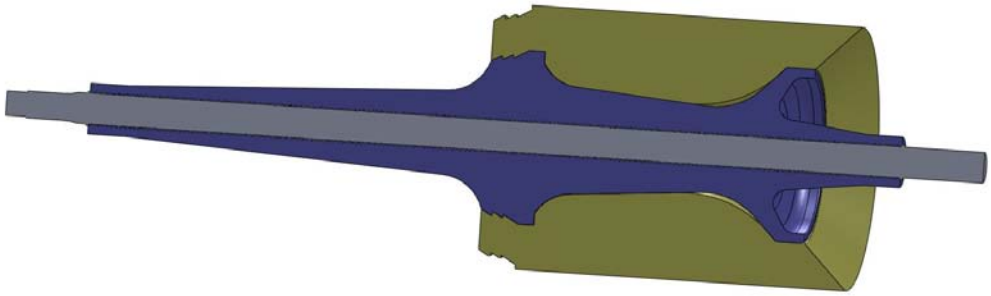

Figure 1. Illustration of a plastic carrier to support a 120-mm projectile in a 7” HARP cannon.

This paper will present the design details and structural analyses of both launch and sabot discard along with the results of the proof-of-principle experiments.