Application note

No. 16

Importance of Range instrumentation when the unexpected happens.

EXPERIMENT OVERVIEW

The purpose of the test was to investigate the effect on the flight behaviour of APFSDS projectiles when using propellants at different temperatures. The expected effects at higher temperatures are increased barrel pressures, increased velocities, asymmetric sabot separation and subsequent projectile instability. Velocity measurements were taken with Radar Doppler and projectile behaviour downrange of the muzzle was captured using the SI Tracker 2 system.

EXPERIMENTAL SET UP

Gun launcher:

The APFSDS projectiles were launched using a smooth bore 120mm fixed gun firing horizontally at a target 500m away.

SI Tracker 2 system:

The SI Tracker 2 was located 50m downrange of the muzzle and 50m to the left side of the firing line. The Tracker camera view started 2m ahead of the muzzle and was configured to follow the projectile for 100m.

Triggering and velocity/position correction:

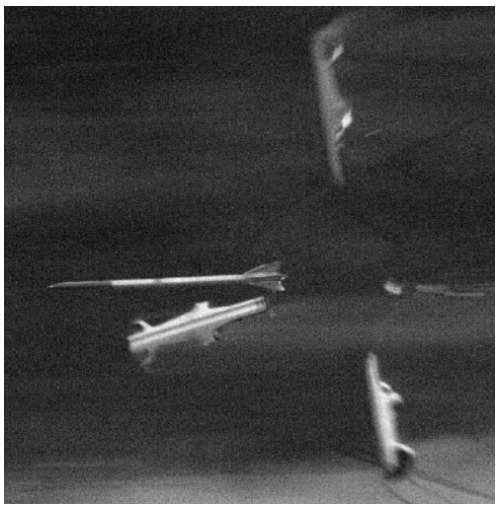
To start the SI Tracker 2 mirror sweep, an SI-OT3 optical trigger was used as a flash trigger (PD1) to detect the muzzle flash. This was located 7m to the left of the muzzle. Two additional OT3 Optical triggers were located at 5m (PD2) and 10m (PD3) locations downrange of the muzzle and 3m to the

right of the flight path. These two units were used to detect the actual position and measure the velocity of the projectile after launch to allow immediate mirror correction for any differences between the predicted and actual muzzle velocity.

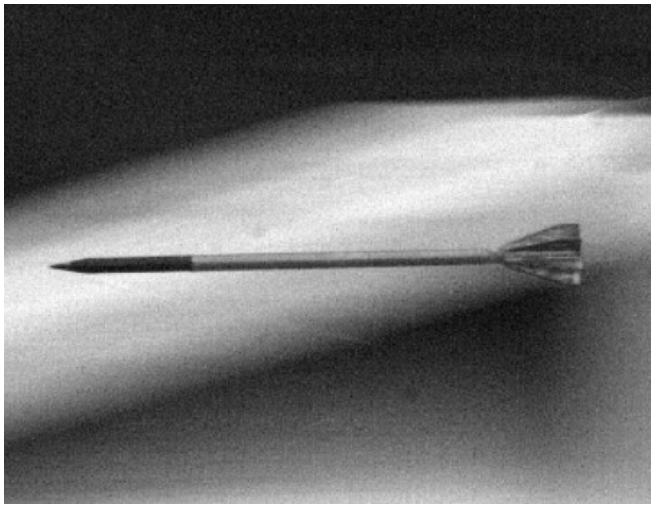
RESULTS

The SI Tracker 2 initially used the predicted muzzle velocity and drag values (m/s/m) which proved to be inaccurate. However, the velocity and position correction provided by the two SI-OT3 units adjusted these values in real time for accurate tracking.

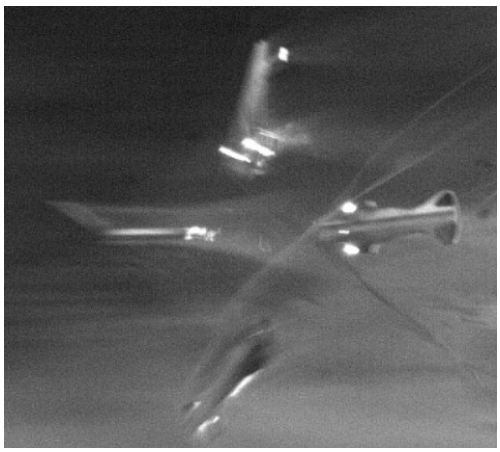
The images below show sabot separtion and APFSDS projectiles approximately 10m and 45m downrange of the muzzle. The top images show correct sepation when using propellant at a lower temperature. The second pair of images show asymmetric sabot separation and projectile break up at 10m and the remaining part (tip behind remains of body) yawing significantly at 45m downrange.

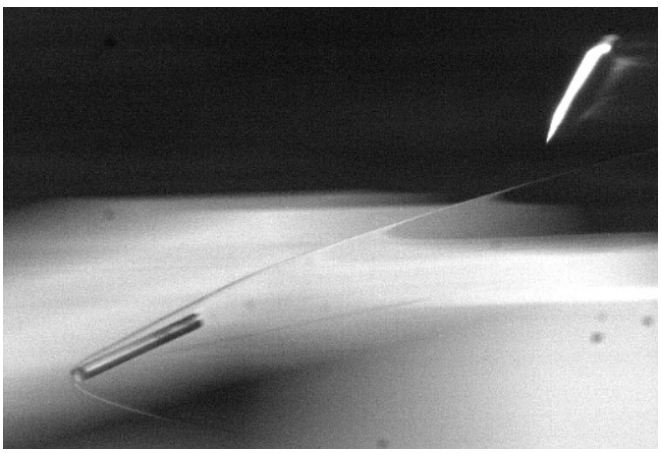


10m (approx.) from muzzle



45m (approx.) from muzzle





CONCLUSIONS

The higher pressures created by the higher temperature propellant most likely caused failure of the sabot within the barrel, and the projectile break up immediately beyond the muzzle. The SI Tracker 2 unit was able to measure the velocity and position of the projectiles (intact and failed) well enough to capture the full 100m flight as intended. This can help establish the failure mechanism created by the higher temperature propellant and the subsequent effect on projectile trajectory.

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