

Impact Force – Executive Summary

Four kinetic-energy non-lethal weapon (KENLW) projectiles were evaluated for impact severity:



40mm BIP (standard)
Security Devices International Inc. (SDI)



40 mm eXact iImpact
Defense Technology



37 mm AR-1 Impact Baton
Police Ordnance Company Inc.



40 mm rubber baton (4557)
Combined Tactical Systems

The test setup included a compressed air powered cannon, a velocity gate and a segmented load plate to measure the force/time history. Upon firing, the projectile accelerated down the barrel, through the velocity gate and out of the barrel toward the target. The segmented load plate was comprised of seven individual load cells all of which are topped with hexagonally shaped impact/distribution pads.

As the projectile exited the air cannon, it traveled approximately 30 cm before striking the segmented load plate. During the impact, the force of each load cell was recorded with respect to time. The summation of each load cell at each time step was calculated resulting in a total impact force/time history.



Seven hexagonal pads and
load cells with cables.

The load cell signal was conditioned with a 47 kHz analog anti-aliasing filter and collected by a data acquisition system sampling data at 100 kHz. The data was then processed using a 40 kHz lowpass digital filter.

Testing was conducted at five different impact velocities. The root-mean-square deviation (RMSD) was calculated to quantify the impact force difference between the four KENLW projectiles. The RMSD was evaluated using 8 force values, using standoff distances between 30 and 100 m. The projectile having the lowest impact force response (BIP standard) was used as the reference to calculate RMSD.

As it relates to impact force testing protocols, the BIP (standard) has a lower, thus safer, “peak of impact force” (RMSD=2311 N). When compared to the CTS rubber baton (RMSD=3362 N), the ARWEN AR-1 (RMSD=8228 N) and the eXact iImpact (RMSD=18,318 N), SDI’s BIP has the lowest impact force. A higher recorded impact force equates to a greater likelihood of injury, though the measure of an injury’s severity is recorded in blunt trauma testing.

From this testing protocol, it is fair to say that of the sample rounds used for comparison, SDI’s BIP is the safest.

