Ballistic Equations: A Compilation of Equations and Methods for Evaluation of Parameters Relevant to Penetration, Blast Effects, and Crater Formation

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Critical to combat system survivability analysis is the ability to estimate the effects of threat-target interactions. However, this ability is particularly challenging given the inherent variability in the fundamental physical processes of detonation physics, fracture mechanics, and penetration mechanics. Thus, the analyst must seek to bound the problem and its solution set (e.g., using first-order estimates) and find a range of possible outcomes given a range of initial conditions. This document is a compilation of equations and methods that form the basis for a number of analytical tools designed to provide first-order estimates of the effects of ballistic-related penetration and blast. Penetration equations include those for small-caliber projectiles, fragments, or shaped charge jets; blast equations include estimation of blast parameters, crater formation, and the deformation and/or fracture of flat or curved plates impacted by blast. Some of these equations are based on first-principle physics; most are empirical in nature. In addition, appendices to the document include relevant THOR data sets, THOR and Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME) penetration constants, and drag coefficients for small-caliber projectiles.

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