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The Effect of Aerodynamic Heating on Air Penetration by Shaped Charge Jets and Their Particles JOSEPH BACKOFEN, BRIGS Co. — The goal of this paper is to present recent work modeling thermal coupling between shaped charge jets and their particles with air while it is being penetrated to form a crater that subsequently collapses back onto the jet. This work complements research published at International Symposia on Ballistics: 1) 1987 - Shaped Charge Jet Aerodynamics, Particulation and Blast Field Modeling; and 2) 2007 - Air Cratering by Eroding Shaped Charge Jets. The current work shows how and when a shaped charge jet's tip and jet particles are softened enough that they can erode in a hydrodynamic manner as modeled in these papers. This paper and its presentation includes models for heat transfer from shocked air as a function of jet velocity as well as heat flow within the jet or particle. The work is supported by an extensive bibliographic search including publications on meteors and ballistic missile re-entry vehicles. The modeling shows that a jet loses its strength to the depth required to justify hydrodynamic erosion when its velocity is above a specific velocity related to the shock properties of air and the jet material's properties. As a result, the portion of a jet's kinetic energy converted at the aerodynamic shock into heating transferred back onto the jet affects the energy deposited into the air through drag and ablation which in turn affect air crater expansion and subsequent collapse back onto the jet and its particles as shown in high-speed photography.

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