PERFORATION OF METAL PLATES: EXPERIMENTAL VALIDATION OF NUMERICAL SIMULATIONS

L. Schwer[1], K. Hacker[2], K. Poe[2]

[1] *Schwer Engineering & Consulting Services*
6122 Aaron Court, Windsor, CA 95492 USA
[2] *Naval Explosive Ordnance Disposal Technology Division*
Research and Development Department, Indian Head, MD 20640 USA

The Naval Explosive Ordnance Disposal Technology Division has a requirement to establish a modeling capability to simulate render safe procedures for unexploded ordnance. To aid in establishing this capability, the Navy has initiated a research and development program that includes modeling studies, research on applicable impact related material parameters, and validation of the modeling results via comparison with experimental results. This paper presents a summary of the progress during the first six months of this effort including a selection of laboratory experiments and their numerical simulation.

The Naval Explosive Ordnance Disposal (NEOD) Technology Division has conducted more than 90 plate impact experiments to support the initial phase of this research and development effort. The target plates include three thicknesses: 0.125, 0.25 and 0.5 inch (3, 6, and 12 millimeters), three materials: A36 Steel, 6061-T65 Aluminum and C2600 Brass, three projectile types: 0.5 Caliber, PAN Steel, and PAN Aluminum slugs, at impact speeds between 240 and 3400 feet/second (70 to 1050 meters/second). The nominally normal projectile impact data includes: pre and post impact projectile speeds and orientations, post-test deformed projectiles, plate deformed profiles, plate plug masses for perforated plates, flash X-ray images, and post-test photographic documentation.

The numerical technique selected to model these experiments is the Smooth Particle Hydrodynamics (SPH) particle technique as implemented in LS-DYNA. The SPH technique offers the advantages of a Lagrangian method without the necessity to select ad hoc erosion criteria to remove highly deformed elements. For the purpose of modeling validation, the plate impact simulations were performed independent of the experiments and without knowledge of the experimental results, i.e. blind predictions. Overall the modeling was quite successful, however a trend was noted that the model results under predict the measured residual projectile velocities as the projectiles became more deformed. An understanding of this trend in the modeling is the subject of continuing research and development.