FURTHER INVESTIGATION OF THE POST CASING FRACTURE FRAGMENT ACCELERATION: EARLY TIME NOZZLE FLOW THROUGH CASING FRACTURES

C.A.Hoing[1,2], M.D. Hutchinson[2], W.G. Proud[2]

[1]*Defence Ordnance Safety Group, Defence Equipment and Support, MOD Abbey Wood, Bristol BS34 8JH, United Kingdom*
[2]*Institute of Shock Physics, Blackett Laboratory, Imperial College London, Prince Consort Road, London SW7 2AZ, United Kingdom*

ABSTRACT

The dynamic expansion of bomb casings, up to their point of fracture, was described by G.I. Taylor in 1944. Also, the radial acceleration of the casing metal, towards an ideal initial flight velocity calculated by R.W. Gurney in 1943, can be approximated by adding a radial dependency to Gurney's velocity. This radial acceleration can be calculated with more accuracy and detail by Eulerian codes which can model the initial shock acceleration as a perturbation on the more gradual outward acceleration produced by the very high pressure explosive gases. Following fracture, however, these gases begin to escape through the fracture lines, leading to doubt as to the capacity of the gases to continue to provide significant outward drive to the casing fragments. P.W. Cooper, for example, has stated that 'acceleration stops'. However, in 1975 Karpp and Predebon calculated the rate of gas escape through fractures and showed that acceleration continued, at a modified level, post-fracture. These authors also made reference to confirmatory experiments at Ballistics Research Laboratory, USA. Similarly, researchers at AWRE had also concluded in 1970 that post-fracture acceleration occurs.

The general approach for the calculation of the rate of gas escape is to employ ideal nozzle flow theory to the flow through these developing fractures. This paper will present results of initial numerical simulations undertaken to investigate the validity of applying ideal nozzle flow throughout the post casing break up fragment acceleration history. As the initial data reported shows a break down in this approximation early in the acceleration history, future shock tube experiments and more detailed numerical studies are proposed.