# METHODOLOGY FOR SIMULATING BLAST LOADING ON ARMORED PANELS USING A GAS GUN

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## ABSTRACT

Testing armored panels in blast loading typically requires the use of explosives. This poses challenges related to available test sites and safety of personnel and equipment. Evaluating variations of armor panel construction is thus costly and time consuming. To address these issues, a non-explosive based methodology is presented using a gas gun. The projectile impacts a spreader plate placed in front of the panel to increase the impact area. Benefits include a controlled environment, high speed camera use, and quick panel change out. The methodology is suited for quantitatively assessing panel performance to be further studied with explosives.

## I. INTRODUCTION

Testing armor panels is typically done with live explosive charges at outdoor remote locations. Equipment and personnel must be relocated on site. The resulting fire-ball and dust cloud after the explosion is a significant impediment to direct observation of the panel response during impact. An alternative methodology is proposed using a gas gun in a laboratory controlled environment. Pressurized nitrogen accelerates a 2.756kg steel projectile at speeds up to 74m/s. The 70mm diameter projectile strikes a series of aluminum and foam plates layered in front of the target, which serves to spread the force over a wider 304.8 x 304.8 mm area, similar to the pressure front of the explosive-based tests. The incoming projectile crushes the foam and uses the aluminum to transmit the impulse from projectile to spreader plates to panel. The projectile comes to rest momentarily, thereby using the available impulse to deform the armored panel and accelerate a transmission plate attached to the backside. The impulse absorbed by the panel is the difference of the input projectile momentum minus the departing flying transmission plate momentum.

## II. RESULTS

High speed camera still-image captures demonstrate a baseline 6.35mm thick rolled homogeneous armor (RHA) steel panel impact test (see Fig. 1). All other specimens were sandwich panels using aluminum honeycomb and expanded metal, ceramics, T-flex fibers, among the more common materials. Performance, measured as a function of absorbed impulse per unit weight, showed significant improvements over the baseline steel of up to 83%, with the average showing 38%. Dent depth, by contrast, favored the steel panels which exhibited no permanent deformation while the sandwich panels averaged 5.83mm.

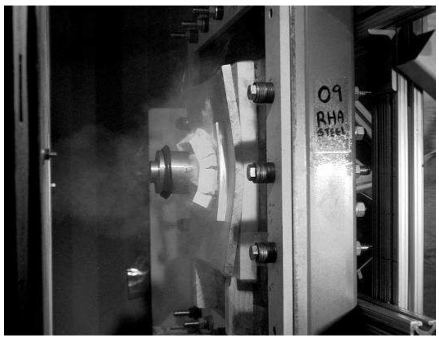


Fig. 1. RHA steel panel, t=250ms after impact

## III. CONCLUSIONS

The test methodology provides consistent means for evaluating various armored panel designs based on the initial impulse from a projectile and the output impulse of a transmission plate. Testing different panel designs demonstrated performance improvements over a baseline steel specimen.