Aluminum alloys have been widely used in light and medium armored vehicles since the 1950s because of their superior ballistic performance-weight balance combined with their good weldability, their ease of fabrication and their availability in a large range of product forms. With the recent conflicts in Iraq and Afghanistan, new threats have appeared which made necessary to significantly improve the ballistic resistance of all materials used for armor plates, including aluminum alloys, as well as to develop new materials with enhanced specific properties. To support this development, it is necessary to better understand the material behaviour during a ballistic impact and the associated dynamic mechanisms.

In this context, the ballistic performances of a selection of standard and premium aluminium alloys produced by Alcan Global Aerospace Transportation & Industry have been tested at the French-German Research Institute of Saint-Louis (ISL): 5083-H131, 6061-T6, 7020-T6, 7449-T6, and newly developed 2139-T8. Two types of projectiles were used: 0.3 cal AP and 20 mm FSP. Projectile velocities were selected to guarantee the full perforation of the plates for standard alloys and the residual velocities were measured by X-Ray flashes behind the tested plates.

The ballistic performances of alloys were compared in terms of residual velocity and number of projected fragments. The AP-FSP performances balances of each alloy are compared in Figure 1. Post-mortem optical and electronic sectional observations of the perforated plates were performed and the failure mechanisms were classified according to Woodward [1]:

- Low to medium strength alloys (5xxx and 6xxx) failed by ductile hole growth. The residual velocities measured on these alloys were quite high but only a few fragments were projected behind the specimen.
- High strength 7xxx alloys failed by discing (rear plate failure) causing high spalling behind the armor plate and Adiabatic Shear Band (ASB) initiation, propagation and finally shear cracking.
- Premium alloy 2139 exhibited the better AP-FSP balance with a ductile bulging failure mode, as already observed by Lee [2].

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Figure 1: 20 mm FSP / 0.3 cal AP performance balance for the tested alloys (the performance index is calculated as the relative difference between impact velocity and residual velocity, a performance of 100% means projectile stopped)