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Scaling of the Propulsive Capability of Aluminized Gelled Nitromethane JASON LOISEAU, ANDREW HIGGINS, DAVID FROST, McGill University, FAN ZHANG, Defence Research and Development Canada — It is well accepted that small mass fractions (<20%) of micron-scale aluminum particles added to a high explosive can react quickly and with sufficient exothermicity to improve metal-acceleration ability (AA) relative to an equal volume of only the base explosive. In order for the aluminum to increase AA, exothermicity must more than offset losses in gas-production and from heating and accelerating the solid particle in the flow. Furthermore, particles must react promptly to deliver this energy prior to loss in driving pressure with product expansion or acoustic decoupling from the driven material. For these reasons many aluminized formulations exhibit slight or no increase in AA ability. Furthermore, AA ability is typically studied using the cylinder test, which specifies a fixed, heavy copper wall. In the present study the authors have used symmetric sandwiches of flyer plates of varying thicknesses to examine how charge scaling and plate acceleration timescales influence the enhancement in AA for different mass fractions and sizes of aluminum particles. Nitromethane gelled with 4% Poly(methyl methacrylate) by mass was used as the base explosive. 3M K1 microballoons were added at a mass fraction of 0.5% to sensitize the mixture. Mass fraction of aluminum was varied between 10% and 40% and particle size was varied from 2 μm to 100 μm. For small mass fractions of alumimum, an enhancement in AA was observed for all particle sizes and flyer configurations and indicated an onset of reaction very close to the sonic plane of the detonation wave.

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