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Critical Diameter Prediction for Steady Detonation in Gassless Metal-Sulfur Compositions FRANCOIS-XAVIER JETTE, ANDREW HIGGINS, McGill University, SHOCK WAVE PHYSICS GROUP TEAM — Since many heterogeneous mixtures whose reaction products contain no gas are highly exothermic, a possibility exists for steady gassless detonation. Theoretical investigations have focused on approximating the product Hugoniot, which depends to a large extent on the amount of heat released and the volumetric expansion resulting from the reaction. If the products Hugoniot curve lies above the unshocked state on the pressure-volume plane, the Chapman-Jouguet tangency criterion gives the detonation velocity. Such Hugoniot analysis assumes that the rate of energy loss is negligible compared to the reaction rate, a condition approached only when the charge diameter is much greater than the critical detonation diameter. For charges of practical dimension, the lateral losses are not negligible. The current study accounts for the competition between lateral losses and reaction rate in order to predict the critical diameter of a mixture of manganese and sulfur. The reaction rate is based on experimental data obtained via temperature measurements during shock initiation of the mixture.

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