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Modeling the Effects of Confinement during Cookoff of Explosives[1]

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In practical scenarios, cookoff of explosives is a three-dimensional transient phenomenon where the rate limiting reactions may occur either in the condensed or gas phase. The effects of confinement are more dramatic when the rate-limiting reactions occur in the gas phase. Explosives can be self-confined, where the decomposing gases are contained within non-permeable regions of the explosive, or confined by a metal or composite container. Self-confinement is prevalent in plastic bonded explosives at full density. The time-to-ignition can be delayed by orders of magnitude if the reactive gases leave the confining apparatus. Delays in ignition can also occur when the confining apparatus has excess gas volume or ullage. Explosives with low melting points, such as trinitrotoluene (TNT) or cyclotrimethylenetrinitramine (RDX) are complex since melting and flow need to be considered when simulating cookoff. Cookoff of composite explosives such as Comp-B (mixture of TNT and RDX) are even more complex since dissolution of one component increases the reactivity of the other component. Understanding the effects of confinement is required to accurately model cookoff at various scales ranging from small laboratory experiments to large real systems that contain explosives.

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