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Predicting the effects of thermally-induced density gradients on the hydrodynamic behavior of PBX 9502 JOHN YEAGER, LEE PERRY, AMANDA DUQUE, XIA MA, GENEVIEVE WATT, Los Alamos National Laboratory — High explosive charges are nominally uniform density but can develop density gradients if they are asymmetrically heated. Here, we investigate the effects of these thermally-induced density gradients on the shock-to-detonation transition and resulting detonation wave shape in the explosive PBX 9502. Our newly developed approach combines results from COMSOL Multiphysics software with the reactive burn model within the SURF hydrodynamic simulation code. We first used COMSOL to model charges of PBX 9502 with several thermal boundary conditions of varying asymmetry, generating maps of the final temperature, density and deformation. This resulted in spatially varying density as well as differences in the density gradients when different boundary conditions were applied. The data were then binned into domains of average density, partitioned by constant density contours. Appropriate temperature- and density-dependent PBX 9502 SURF burn model constants were assigned to each region and deployed within the hydrocode to predict the shock-to-detonation transition behavior and wave shape in the part. The simulations revealed that detonation propagation and wave shape could both be controlled by choosing a desired density gradient.

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