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Critical Temperature Formula for a Body of Arbitrary Size and Shape LARRY HILL, Los Alamos National Laboratory — The Frank-Kamenetskii thermal explosion model provides a framework for calculating the critical temperature for an energetic material body of any size and shape. The calculation involves finding a dimensionless shape parameter, which, except for the case of an infinite cylinder, must be determined numerically. This exercise is easy enough for simple symmetric geometries such as the infinite slab, infinite cylinder, and sphere, and these results are well known. But for arbitrary bodies the manipulations are cumbersome, to the extent that they are almost never undertaken in practice. It is therefore desirable to deduce a formula that can, to a good approximation, predict the critical temperature of an arbitrary body without the necessity of a heat transfer calculation. Over the past ~ 60 years, several attempts to find a universal formula have been made—none of which have been completely successful. It is not too difficult to develop a methodology that can reproduce the shape factor of the three canonical objects—infinite slab, infinite cylinder, and sphere. The challenge is to develop a methodology, which, while reproducing the three canonical objects, can also correctly distinguish the shape factors of, say, the sphere, cube, and a unity aspect ratio cylinder. I will present a method that can do so.

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