The dynamic of detonation failure in different geometries, and the extension of the critical diameter criterion.

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The criterion of existence of a self-sustained detonation wave is an important parameter to define for safety concern and for engineering conception. As the explosive can be used in different geometries, this criterion should not be linked to a specific geometry. Commonly, it is given as the smallest unconfined cylindrical rod where a detonation can propagate, so called the critical diameter. We aim at measuring more easily this detonation characteristic and at extending this criterion to other geometries.

From basic considerations we propose to use the form factor (ratio of the lateral and normal surfaces during a detonation wave's propagation) to characterize the extinction limit through different geometries. Considering that the criterion will have the same value at extinction whatever the geometry, we find that the known correspondence between slab and cylindrical geometries is respected: the critical width is half the critical diameter. Applying this criterion to slab prisms (the detonation propagates among a decreasing width) we can show that there is a quasi linear relation between the prism's angle and the width at which the detonation wave extincts. This behavior was confirmed by both numerical and ancient experimental studies using this geometry. It provides a way to accurately measure the detonation critical width by extrapolating the linear tendency to zero.

The dynamic of detonation failure in conical charge was presented by Salyer et al. at the 13th International Symposium on Detonation. In their study it can be seen that for small angle cones, the detonation wave extinct at a diameter smaller than the critical diameter and that this extinction diameter in cones tends to the cylindrical one when the angle decreases. If we apply the proposed extinction criterion, we can also show a relation between the extinction diameter and the angle of the cone. We are performing the measure of the dynamic of detonation failure but only with small cones (i.e. included angles of 4, 10, 20 and 40°). Thus, we expect to extrapolate the critical diameter from these experiments and we will compare it to the known value for the explosive tested. We estimate that this measure should be more accurate and require fewer experiments to determine the critical diameter. We also prospect to test the extinction dynamic of detonation in annular cone configurations to extend the validity of the proposed extinction limit criterion.