# NOVEL CHARGE CONFIGURATIONS FOR EFFICIENT BLAST TESTING

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**Abstract:** Blast qualification testing of full-scale military hardware, systems, or structures requires efficient use of explosives during field-trial operations. Basic charge configurations such as spheres made with traditional military explosives such as melt-cast TNT, cast-cured PBX, or hand-packed C4/PE4 have inherent inefficiencies caused by their omnidirectional blast flow-fields, narrow pressure to impulse (P/I) range, risk of non-uniform detonation, and significant logistical burden in their safe manufacturing, transport and storage. Test sites are under increasing constraints to minimize propagated noise and disturbance of the environment. Use of novel configurations and explosive materials can greatly increase the efficiency of explosive material being used by focusing blast conditions towards a localised test area and producing precise P/I ratios not possible with basic charge scaling.

This paper presents a combined experimental and computational study on the development of various novel charge configurations to produce higher intensity, focused blast loading compared to traditional, omnidirectional blast charges of greater explosive mass. The use of a homogeneous liquid nitromethane (NM) explosive ensures a highly repeatable uniform detonation, free from anomalies of typical solid explosive charges, as well as allowing novel charge shapes and configurations to be readily produced and prepared in the field.

Exploratory computational fluid dynamics modelling was performed to identify promising configurations for achieving a defined P/I condition on a prescribed target area using the least amount of explosive material by a relatively simple means of manipulating charge shape and test configuration.

The use of confinement was shown to be highly efficient for focusing and amplifying small explosive charges to produce higher blast loadings at the target area. Novel charge geometries, made possible with the use of liquid explosives provides an additional mechanism to focus blast loading along a particular trajectory and produce unique P/I conditions not possible from basic shapes such as spheres or hemispheres. And finally, the use of multiple simultaneously detonated charges was found to produce a highly tuneable charge configuration which can achieve a wide range of P/I conditions from a fixed explosive mass. Experimental testing was performed to further explore the blast enhancement techniques and establish a validated numerical modelling approach allowing the computational design of blast surrogates for a wide range of blast qualification testing needs.