NON-IDEAL AIRBLAST SIMULATION IN SHOCK TUBES

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Theoretical and experimental investigations of techniques for shock tube generation of non-ideal (thermally precursed) airblast waveforms are reported. Both 1 and 2D techniques are considered.
1D techniques employ combinations of multiple explosive charges and sections of gas mixtures of varying densities to produce desired static and dynamic pressure environments in the test section. 2D techniques use a layer of low density gas (He) on the floor of the shock tube to simulate the nuclear thermal layer in a gasdynamics sense. The 1D approach has the advantage of ease of prediction and shows excellent agreement between theory and experiment. However, it requires a detailed prior knowledge of the desired airblast characteristics, and tends to be low fidelity due to practical limitations in the number of charges and gas sections which can be fielded. The 2D approach has the advantage of more realistic simulation of non ideal phenomenology. In fact, some reported experimental results show high fidelity matching with selected scaled non-ideal nuclear waveforms. However, the interaction of non-axial flow components with the tube walls and ceiling limit simulation to substantially smaller scales than those obtainable with 1D techniques. Other problems include the presence and flow modification effects of the layer confinement medium, and lack of planarity in driving waveforms due to short distances between explosive drivers and heads of simulated thermal layers. This latter problem has been largely alleviated by the development of ultra-thin drivers made of explosive sheets which are actually detonated outside open tube ends.