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A comprehensive theory for the response of gases to localized, transient heat addition DAVID R. KASSOY, Retired — The response of a gas to localized, transient heat addition depends upon the amount of energy added during the heating period and the ratio of the heating time scale, t(H) to the local acoustic time, t(A). When the ratio is small the process occurs at nearly constant volume conditions, pressure rises with temperature while the density decrease is small. The local expansion Mach number is small. Gas expelled from the boundary of the high-pressure hot spot is the source of mechanical waves in the unheated environmental gas. The range of responses includes acoustic waves, shocks and very strong blast waves. When the amount of energy added exceeds an explicit limit the heating process is fully compressible with a substantial internal Mach number. When the time scale ratio is large energy addition to the volume leads to a nearly constant pressure process with the density inversely proportional to the rising temperature. The local expansion Mach number will range widely, depending on the amount of energy added and the size of the now large time scale ratio. Finally, a systematic formulation for the acoustic response of a gas, confined in a rectangle, to modest spatially distributed transient energy addition on a heating time scale t(H)=O(t(A)) is described.

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