Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

A Numerical Study on Effects of Pressure and Gravity on Opposed Flow Flame Spread Rate over Thin Fuels RANJIT SHUKLA, AMIT KUMAR, IIT Madras — In the recent years there has been renewed interest on effects of low pressure on combustion processes especially because of increased human endeavors in space. As access to space is expensive and so researchers have tried emulating effect of reduced gravity with reduced pressures at normal gravity. One such area of interest has been studies on spreading flames over condensed fuels. These studies are primarily driven by need of fire safety in low convection space environment. In quiescent space environment flame spread against the flow has been known to exist even where concurrent flame spread is not possible. Therefore, here in this work a 2D numerical model has been formulated to analyze the effects of pressure and gravity on flame spread behavior in an opposed flow configuration. An attempt is also made to arrive at pressure-gravity equivalence. The numerical model comprises of governing conservation equations for solid phase and gas phase. The 1D solid phase model (thin fuel) for ideally pyrolysing fuel is coupled to the gas phase by boundary conditions. Simulations carried over a range of gravity level from microgravity to the normal gravity and sub atmospheric pressures up to flame extinction show that the flame spread behavior and extinction is qualitatively the same from partial gravity of about 0.1g to 1g but quite different at near zero gravity. While the former is amenable to pressure-gravity equivalence modeling, the latter is not.

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Date submitted: 02 Aug 2012 Electronic form version 1.4