

Abstract Submitted  
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**Upward penetration through  
a granular medium** D. COSTANTINO, Penn State; Physics Department, T.J. SHEIDEMANTEL, M.B. STONE, J. COLE, C. CONGER, K. KLEIN, M. LOHR, W. MCCONVILLE, Z. MODIG, P. SCHIFFER — We measure the force needed to push a flat plunger upwards through a granular medium. The plunger begins flush with the base of the grains' container, and we focus upon the force necessary to initiate motion. The data show that this break-out force increases monotonically with plunger diameter and pile height as expected. In contrast to previous measurements of the force needed for vertical penetration from above and of the horizontal drag force, this break-out force has a strong dependence on the diameter of beads making up the pile. The nature of this bead size dependence can be altered by using different methods to form the grain pile. Implications for the relevant force chain network will be discussed. Research supported by NASA grant NAG3-2384 and the NSF REU program.

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