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Baseball and softball are chiefly played on a small, un-vegetated portion of the field termed the “infield skin.” This area is highly maintained because its state intimately affects gameplay.

An ideal infield surface allows players’ cleats to penetrate the soil and provide adequate traction but impart minimal disruption during play. This state has been termed the “cleat-in/cleat-out effect.” As an infield soil dries, it transitions from a cleat-in/cleat-out state to a more brittle condition in which the primary yield mode is chip-forming or clod-forming failure. Large surface irregularities formed in this state may deflect batted balls and induce fielding errors or injuries.

The goal of this research was to develop a laboratory test to identify the critical water content corresponding to the cleat-in/cleat-out behavioral threshold for any soil.

A pneumatically-driven device was fabricated to emulate an athlete’s footstrike. The apparatus applies both compressive and shearing stresses. It may be configured to loading pressures comparable with either youth or professional competition.

To perform the test, a cylindrical soil sample is prepared using Proctor testing equipment and then subjected to wetting and drying cycles. The pneumatic device is actuated to produce several cleat indentations on the soil surface. A 3D scanning technique quantifies the surface’s Dirichlet Normal Energy (DNE). is measured using a combination of 3D scanning and gravimetric methods. The soil is tested at a range of water contents over successive days.

for a given soil is determined by plotting DNE against , fitting a polynomial curve to the data, and optimizing the function to solve for . The method allows to be pinpointed for any soil. Good correspondence was achieved across replicate specimens. It is envisaged that the device will find utility in future investigations of infield mix design.