

1-SHOCK ABSORPTION

G_{max} TEST

To evaluate the surface's capacity to absorb head impacts, a mass of 9,8kg (20 pounds), which represents the weight of a human head and neck combined, is dropped from a standard height (61cm). This simulates 85% of impacts experienced in football. Results are expressed in "g" (acceleration due to gravity) which represents the maximum deceleration experienced by the head during the impact.

According to the Consumer Product Safety Commission (CSPC), a surface is acceptable if maximum G_{max} results are under $200G_{max}$. The $200G_{max}$ level threshold is based upon several studies performed on cadavers and animals. Some tests (dropping of adult cadavers) performed by Hodgson et al. demonstrate that at a peak deceleration in the range of $190G_{max}$, a level 5(dangerous for life) fracture is observed. A $150G_{max}$ and lower result should be seriously considered as a safety factor.



Typical impact tester.

Berlin Athlete

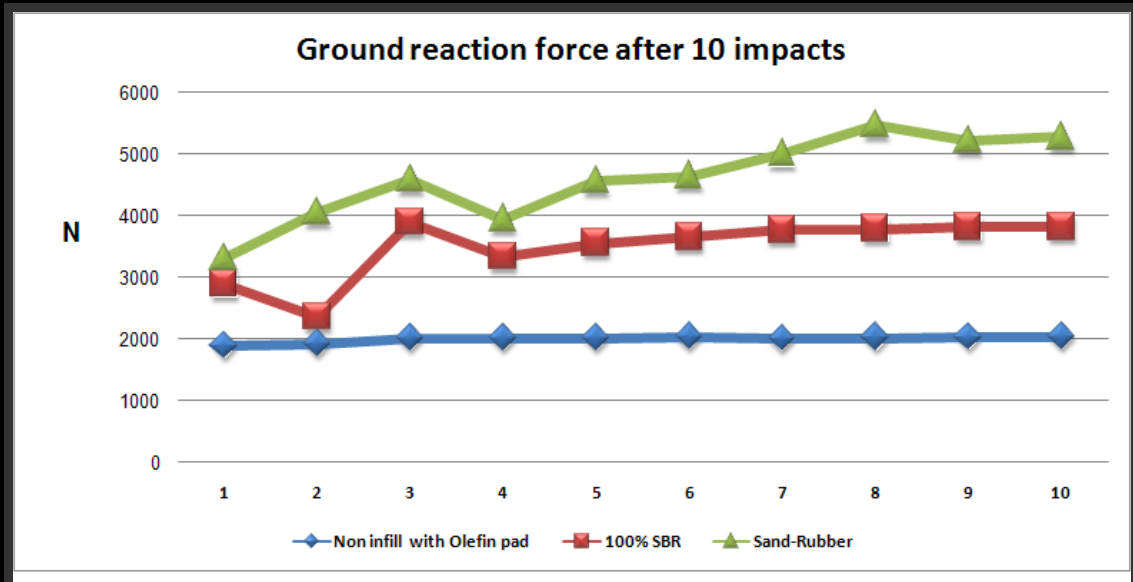
To the opposite, sport impact studies in Europe have been concerned with the pounding of athletes' feet on various running surfaces. In Europe, the shock absorbency, energy restitution and vertical deformation are measured using a device called the Berlin artificial athlete in order to meet the FIFA and UEFA standard requirements.



Berlin artificial athlete apparatus.

Regularity

In order to be safe, a playing field should always be constant in its shock absorbency level even when it comes to repeated athlete interaction with the surface on the same spot. This figure shows the effect of a repeated impact (10 consecutive impacts) in the same location without any field maintenance.



Typical ground reaction force after 10 impacts without maintenance.

2-TRACTION

Traction & performance

When a player runs on a surface, he needs sufficient traction to be able to accelerate and decelerate as necessary. We know that the shoe/surface interaction is the first factor that influences adherence. It is assumed that a good static traction coefficient for a surface/shoe combination is between 0,6 and 1,0 (Shorten. 2003) for recreational activity. When high horizontal forces are applied, the shoes can shear horizontally and this dynamic resistance is called the dynamic traction coefficient. To avoid injury caused by a drastic loss of grip, this coefficient should be higher than 0,5.



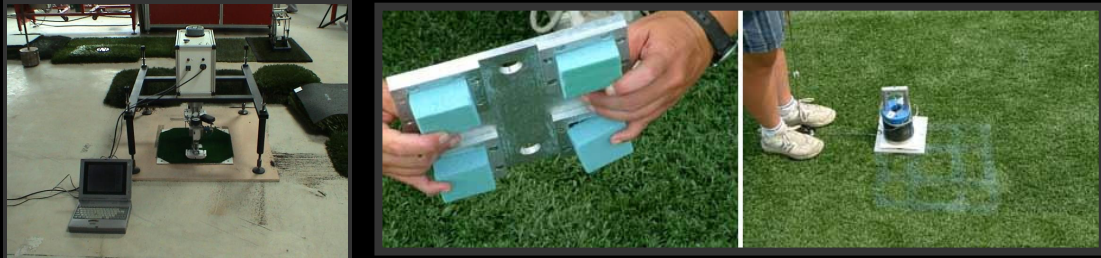
Traction & safety

Another aspect of the interaction between the shoe and the surface is the ability of the surface to release the foot on a rotational movement. We know that the friction coefficient has to be optimal for performance. To the opposite, the frictional resistance against rotational force should be the least possible for safety. If the frictional resistance against rotational force is too high, there is risk of injury to knees and ankles causing a "foot lock" situation. In some studies (Valiant, 1993), it is shown that the athlete adapts to the surface to obtain a "natural" torque of 20Nm. In this case, a good surface gives a moment of rotation (torque) in the range of 30Nm using the steel disc method. The latest FIFA data shows that values for natural turf are between 25-50Nm.



3- ABRASION

Abrasiveness is measured using ASTM F1015 method. Friable foam blocks are attached to a weighted platform that is pulled over the playing surface in four different directions. The weight of foam abraded away determines the relative abrasiveness of the surface. The friable foam blocks used as testing material are rigid closed-cell isocyanurate. An abrasiveness index is created by taking the weight loss of each set of four blocks (in grams) and then it is divided by 0.0606 as per ASTM F1015.



European and American method to evaluate skin

4- STABILITY

During abrupt directional changes, the ankle's axis is exposed to high stress resulting in injury. The most common type of ankle injury is a sprained (stretched or torn) talofibular ligament on the outside of the ankle, although if it is serious, damage can occur to the calcaneofibular ligament. 80% of the ankle injuries occur when you roll the foot inward, this is called an inversion injury.

Issues that influence the stability of the ankle during a cutting movement are: -

- 1- The height of the studs (too long, the higher the rotational axis of the ankle from the surface resulting in less stability).
- 2- Local deformation on the edge of the sole during force application.

Due to the variety of stud types in the market, we have concentrated on the mechanical evaluation of 3 major types of sole available. The higher the required force needed to invert the ankle, the better the stability of the surface.



NEXXFIELD artificial ankle

5- TEMPERATURE



6-VERTICAL BALL BEHAVIOUR

If the ball bounces higher than expected, the player may fail to control the ball or the ball may bounce over him or bounce too low and pass under a raised foot. Vertical ball rebound is used to measure rebound height by dropping a soccer ball from 2 meters and then the rebound of the ball is measured.



7-BALL ROLL

A ball moving on the ground towards a player more quickly or slowly than anticipated can result in a loss of control of the ball.

To test the ball roll, the ball is dropped from a height of 1 meter on a 45 degree angled ramp. When the ball stops its roll, the measurement is taken from the starting point to where the ball stopped.



8- ANGLE BALL REBOUND

In practical terms, a ball hit at an angle and speed, particularly a long ball, will bounce off the surface at a certain angle and speed. If the ball comes off the surface at a different trajectory and speed than anticipated, it makes it difficult to control the ball. Hence the need to measure the combined effects of Angled Ball behavior.

