

## Racetrack Surfaces Consistency



Racing Surfaces  
Testing Laboratory  
Orono Maine USA

This document is a condensed version of

**“Racing Surfaces: Challenges and Approaches in Optimizing Track Surfaces to Reduce Horse Injuries,”** a white paper drafted as a collection of published scientific papers and data. The white paper will be updated as new scientific studies and track data become available. It can be viewed in its entirety at:

[http://www.grayson-jockeyclub.org/resources/White\\_Paper\\_final.pdf](http://www.grayson-jockeyclub.org/resources/White_Paper_final.pdf)

This overview summarizes

**“Racing Surfaces: Challenges and Approaches in Optimizing Track Surfaces to Reduce Horse Injuries”**

by Michael “Mick” Peterson, Ph.D., Lars Roepstorff, DVM, Ph.D., Jeffrey J. Thomason, Ph.D., Christie A. Mahaffey, M.Phil, C. Wayne McIlwraith, BVSc, Ph.D. It is intended for racetrack management, horse owners, trainers, journalists, and others with an interest in racing surfaces that combine performance and consistency with safety.

This document is a synopsis of the key topics of the white paper:

- How the track influences the hoof and the loading on the leg of the horse
- Design and composition of racetracks
- Testing of racing surfaces for consistency
- Racing surface safety

At racing speeds reaching 38 mph, the hoof hits the track approximately 150 times a minute. The hoof remains on the ground for a sixth of a second each time in what is known as the “stance” phase. During that short duration, the stance phase comprises several distinctive stages that have potential for causing very different injuries. For the purposes of this paper, we refer to four stages:

- **Primary Impact:** The hoof first impacts the ground with a relatively low force on the hoof because the horse’s weight has not yet shifted to that limb.
- **Secondary Impact (slide and stop):** As soon as the hoof is at rest on the surface, the body (which is still moving) tends to push the loaded leg forward, forcing the hoof to slide and then stop.
- **Support:** At this point, the hoof and leg are supporting the highest load
- **Rollover:** The hoof rolls forward and then pushes off from the ground.

Certain track properties influence the force of the hoof and underlie the potential cause of injury to bones and soft tissues in the whole leg:

- **Vertical Stiffness or Hardness of the track**
- **Horizontal Slide or Shear Response of the track**
- **Dynamic Tuning or Bounce of the track**

A properly prepared track that is uniform throughout its course should positively influence the performance and orthopaedic health of the horse.

To date, little collective consideration has been given to the design of the racing surface. The design of racetracks has generally been at the control of experts who have developed independent strategies appropriate to particular climates and materials. The approaches of these experts have differed from site to site, sometimes resulting in drastically different track designs in close proximity to each other. This belies the claim that the design must adapt to local materials. However, there is evidence suggesting that local precipitation has influenced some decisions regarding track design and surface material combinations. These different designs should have advantages with respect to safety. If the achieved level of safety is not significantly different for these surfaces, then ease of maintenance and other considerations may be factors that result in an optimal design for a region.

Laboratory performance testing is needed both to evaluate the performance of the track material and to determine if the composition produces performance values similar to other racing surfaces. Laboratory performance testing measures variables such as:

- **Shear Strength:** The shear strength of the top layer material is the most fundamental characteristic of the performance of the track. It influences the slide during secondary impact and the degree of slip during rollover.
- **Compaction:** The compatibility of the surface material determines the effect of horse traffic between maintenance of the material as well as the ability of a material to form a solid base under the track.
- **Impact Absorption and Energy Return:** The manner in which energy is absorbed in the track material has not been previously investigated and must be better understood to develop a system that monitors both the safety and speed of surfaces.
- **Moisture Sensitivity:** For dirt and turf surfaces, there is a need to understand the relationship between the water content and the surface performance.

Laboratory tests are essentially limited to ensuring that a track is consistent over time. In addition, on-site performance testing should be used to describe the overall performance of the material with respect to the design of the track. On-site testing takes a closer look at variables such as:

- **Moisture Content:** This is the single, most important variable on dirt or turf surfaces.
- **Depth:** Depth of the top layer is a critical and relatively straightforward measurement on shallow, sand track surfaces.
- **Material Consistency:** One of the continuing challenges for surfaces is the difference in wear and movement of material in the surface.
- **Temperature:** For synthetic surfaces that operate with minimal maintenance and have not worn significantly, temperature is the equivalent factor of moisture in turf and dirt tracks in the discussion of key variables for the surface.
- **Geometry:** The geometry of the racetrack has been demonstrated to be important in Standardbred racing. This includes the turn radius, banking, and transitions from the straight to the banked turns. While scientific evidence does not exist to demonstrate the optimal design of the turn for a Thoroughbred, logic suggests that the transitions should be smooth and consistent.
- **Overall Performance:** When possible, tools should be used which allow the effect of all of these variables to be taken into account. This requires a system that replicates the loads and loading rates associated with a horse at a gallop.

Beyond the tools needed to monitor racing surfaces, there is a need to understand what is done to the surface and how these surfaces are used. The condition of a racing surface is a result of maintenance, material, weather, and usage. A complete understanding of the surface can only be obtained if these factors are all evaluated to understand the outcome in terms of surface performance. The first aspect of a large-scale project is to understand the interaction of climate and track surface design. Once the track design is known, a protocol for monitoring can be developed. Aspects of the track that are crucial for some designs are less important for other designs. For example, top layer depth must be carefully monitored for shallow sand tracks used in areas with heavy rainfall. In contrast, tracks that are maintained with a “pad” under the top layer have few issues with the depth of the top layer. The challenge on tracks with a pad is that the compaction of the pad must be carefully monitored to ensure that the pad is consistent and does not vary between major renovations. Thus, a combination of factors associated with the design results in a surface that is harder or softer, faster or slower, and more or less consistent. To the extent that these factors can combine in a positive manner, the racing surface will either perform better or worse, and will be either safer or more prone to cause injury.

**Racing Surfaces Testing Laboratory**, a nonprofit corporation, provides testing and consultation of racetrack surfaces for performance and safety. While the pursuit of improved safety for horse and rider is a common goal across racetrack constituencies, the immediate top priorities are high performance and consistent track surfaces. Founded by Dr. Michael “Mick” Peterson, University of Maine Libra Foundation Professor for Engineering, and C. Wayne McIlwraith, Colorado State University Professor of Surgery and Director of Orthopaedic Research, Racing Surfaces Testing Laboratory has developed test protocols now in use at more than 30 horseracing venues around the world. The nonprofit, Racing Surfaces Testing Laboratory, is the result of years of research and development of these protocols.

---

*To read the full version of this White Paper, “Racing Surfaces: Challenges and Approaches in Optimizing Track Surfaces to Reduce Horse Injuries,” please go to:*

[http://www.grayson-jockeyclub.org/resources/White\\_Paper\\_final.pdf](http://www.grayson-jockeyclub.org/resources/White_Paper_final.pdf)

Michael “Mick” Peterson, Ph.D.

Racing Surfaces Testing Laboratory      2 Summer Street #1, Orono, Maine 04473

Ph: 207-409-6872      [racingsurfaces.org](http://racingsurfaces.org)      [mlpeterson23@gmail.com](mailto:mlpeterson23@gmail.com)