



## Turf & Soil Diagnostics

January 17, 2017

Paul Hagy  
Texas Sports Sands  
702 Easy Street  
Garland, TX 75042

TSD File #17010015

Enclosed are the results of the 1830 Bunker White sample. This sample was evaluated for use in sand bunkers. These results are being compared to published guidelines for bunker sands.

To measure the potential of a sand to produce fried egg lies or buried balls, we measure the resistance of the sand to ball penetration using a penetrometer. Values between 1.8 and 2.4 kg/cm<sup>2</sup> are considered acceptable with values above 2.4 kg/cm<sup>2</sup> considered desirable. The sample has a penetrometer value of 4.5 kg/cm<sup>2</sup>, which is a desirable reading.

The crusting and setup values suggest that bunkers with this sand in place may require some raking after rainfall or irrigation events.

The infiltration rate of this sample meets the recommended minimum infiltration rate of 20 in/hr for a well-drained bunker sand.

It is desirable for a bunker sand used in green side bunkers to be compatible with the rootzone to reduce the risk of layering on the greens. The particle size results indicate the sample meets the bunker sand guidelines and USGA recommendations for greens. This suggests the sample should have a minimal risk of layering if this sand is splashed from green-side bunkers onto nearby USGA style greens.

Despite this testing, bunker sand selection is highly subjective. Aside from playability, factors such as color and aesthetics are often weighed in the decision process. We recommend that golf course superintendents, pros, greens committee chairs, and any other interested parties visit a club with the sand in use. Play into and out of it to see how they like it.

If you have any questions or are in need of further assistance, please do not hesitate to contact us. Samples are generally kept on the premises for 45 days after report date. Thank you for using Turf & Soil Diagnostics, Inc.

Sincerely,

Duane K. Otto  
Vice President



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 Paul Hagy  
 702 Easy Street  
 Garland, TX 75042

Date received Jan-12-2017  
 Date Reported Jan-17-2017  
 Facility Product Development

### Bunker Sand Evaluation

| Lab ID#    | Sample Name       | Dry Color | Wet Color | Penetrometer Value<br>kg/cm <sup>2</sup> |
|------------|-------------------|-----------|-----------|--|
| 17010015-1 | 1830 Bunker White | White     | White     | 4.5                                      |
|            |                   |           |           |  |

| Lab ID#    | Sample Name       | Shape<br>Angularity    | Shape<br>Sphericity | Crusting | Set-Up   |
|------------|-------------------|------------------------|---------------------|----------|----------|
| 17010015-1 | 1830 Bunker White | Angular to Sub-Rounded | Medium to Low       | Slight   | Moderate |
|            |                   |                        |                     |          |          |

#### Bunker SOP

Samples were tested as received and comments pertain only to the samples shown.

This report may not be reproduced in part, but only in full.

Sample condition upon receipt was normal.

Samples were received without a transmittal letter.



Photomicrograph of Lab ID 17010015-1 1830 Bunker White.

Reviewed by Duane K. Otto



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**Particle Size Evaluation\***

| Lab ID#                             | Sample Name       | % Retained mm (US sieve) |                        |                     |                               |                    |                       |                    |                     |                    |                    |                       |
|-------------------------------------|-------------------|--------------------------|------------------------|---------------------|-------------------------------|--------------------|-----------------------|--------------------|---------------------|--------------------|--------------------|-----------------------|
|                                     |                   | % Sand<br>2.0 - 0.05 mm  | % Silt<br>0.05-0.002mm | % Clay<br>< 0.002mm | Gravel<br>4.0 (5)             | Gravel<br>2.0 (10) | V. Coarse<br>1.0 (18) | Coarse<br>0.5 (35) | Medium<br>0.25 (60) | Fine<br>0.15 (100) | Fine<br>0.10 (140) | V. Fine<br>0.05 (270) |
| 17010015-1                          | 1830 Bunker White | 97.0                     | 1.5                    | 1.6                 | 0.0                           | 0.0                | 6.0                   | 81.7               | 7.4                 | 1.2                | 0.4                | 0.4                   |
| USGA Recommendations for Greens     |                   | ≥ 92%                    | ≤ 5% Silt              | ≤ 3% Clay           | ≤ 3% Gravel<br>≤ 10% Combined |                    | ≥ 60% Combined        |                    | ≤ 20%               | ≤ 5%***            |                    |                       |
| Bunker Sand Guidelines <sup>1</sup> |                   |                          | ≤ 3%                   |                     | ≤ 2%                          | ≤ 15%              | 78 - 100%             |                    |                     |                    | ≤ 5%               |                       |

<sup>1</sup> From Golf Course Management 54:64-70, 1986

<sup>2</sup> From USGA Green Section Record 36:9-12, 1998

| Lab ID#                             | Sample Name       | Uniformity<br>Coefficient<br>Cu | D15<br>mm | D50<br>mm | D85<br>mm | Shape<br>Angularity    | Shape<br>Sphericity | USDA<br>Textural<br>Classification | Acid<br>Reaction | Infiltration<br>Rate**<br>in/hr | Infiltration<br>Rate**<br>cm/hr | Bulk<br>Density<br>g/cc |
|-------------------------------------|-------------------|---------------------------------|-----------|-----------|-----------|------------------------|---------------------|------------------------------------|------------------|---------------------------------|---------------------------------|-------------------------|
| 17010015-1                          | 1830 Bunker White | 1.9                             | 0.51      | 0.69      | 0.93      | Angular to Sub-Rounded | Medium to Low       | Sand                               | Severe           | 167.9                           | 426.5                           | 1.53                    |
| Bunker Sand Guidelines <sup>2</sup> |                   | -                               | -         | -         | -         | -                      | -                   | -                                  | -                | > 20                            | > 50                            | -                       |

\*ASTM F1632 Method A & Determination of Size Factors SOP

\*\*ASTM F1815 30 cm Tension

\*\*\*Maximum of 10% combined on Very Fine Sand, Silt, and Clay fractions.

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