



Turf & Soil Diagnostics

January 21, 2022

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22455 WCR 49
La Salle, CO 80645
TSD File #22010045

Enclosed are the results of the Bunker Sand (1-13-22) sample received by our laboratory on 1/17/2021. This sample was tested as received for potential use as bunker sand. Bunker sand criteria published in a 2020 issue of the USGA Green Section Record are referenced in this report.

The particle size test results indicate that the sample is uniformly graded sand with most of the particles in the medium and coarse sand size fractions. The particle size results meet bunker sand guidelines. The very fine sand content is higher than USGA putting green recommendations. The gradation suggests the sand may present a layering risk if splashed from green-side bunkers onto coarser graded greens.

The sand particle shape is angular to subrounded. Generally angular sands are preferred for bunkers.

There is no crusting of the sand after wetting and drying. This suggests that bunkers with this sand in place shouldn't require significant raking after rainfall or irrigation events.

A minimum infiltration rate of 30 inches per hour is generally recommended for bunker sand, though some construction methods may differ. The sand has infiltration rate above this minimum.

To measure the potential of a sand to produce fried egg lies or buried balls, resistance of the sand to ball penetration is measured with a penetrometer. The sample has a penetrometer reading of 2.5 kg/cm². While there are varying assessments of this test, results above 2.4 kg/cm² are generally considered more desirable as they suggest potential for fewer instances of buried lies.

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 interested parties visit a club with the sand in use, play into and out of it, and see how they like it.

If you have any questions or need further assistance, please contact us. Samples are generally kept on the premises for 45 days after report date. Thank you for using Turf & Soil Diagnostics, Inc.

Sam Ferro
President



Turf & Soil Diagnostics

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Date Received Jan-17-2022
 Date Reported Jan-21-2022
 Facility Product Development

Bunker Sand Evaluation*

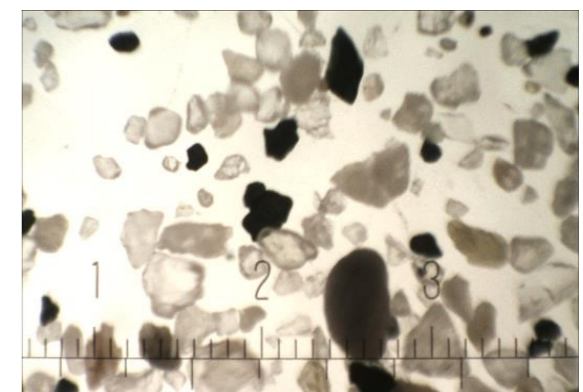
Lab ID#	Sample Name	% Sand 2.0 - 0.05 mm	% Silt 0.05-0.002mm	% Clay < 0.002mm	Gravel 4.0 (5)	Gravel 2.0 (10)	% Retained mm (US sieve)					
							V. Coarse 1.0 (18)	Coarse 0.5 (35)	Medium 0.25 (60)	Fine 0.15 (100)	Fine 0.10 (140)	V. Fine 0.05 (270)
22010046-1	Bunker Sand (1-13-22)	99.3	< 1.0	< 1.0	0.0	0.0	9.1	31.2	37.7	15.2	4.1	1.9
Bunker Sand Guidelines ¹			≤ 3%		≤ 2%		≤ 15%	78 - 100%				≤ 5%
USGA Recommendations for Greens		≥ 92%	≤ 5% Silt	≤ 3% Clay	0%	≤ 3% Gravel ≤ 10% Combined		≥ 60% Combined		≤ 20%	≤ 5%***	

Lab ID#	Sample Name	Uniformity Coefficient Cu	D15 mm	D50 mm	D85 mm	Shape Angularity	Shape Sphericity	USDA Textural Classification	Acid Reaction	Infiltration Rate** in/hr	Infiltration Rate** cm/hr	Bulk Density g/cc
22010046-1	Bunker Sand (1-13-22)	3.0	0.20	0.42	0.88	Angular to Sub-Rounded	Medium to Low	Sand	None	43.2	109.8	1.57
Bunker Sand Guidelines ¹		2.0 - 5.0	-	-	-	-	-	-	-	> 30	> 75	-

USGA Rootzone Coefficient of Uniformity Recommendations: 1.8 to 3.5 for Mixes with Peat; 2.0 to 3.5 for Mixes with Inorganic Amendment or Pure Sand.

**TSD Infiltration Rate SOP

Lab ID#	Sample Name	Dry Color	Crusting	Penetrometer Value kg/cm ²	Angle of Repose	
					Angle (°)	Shape of Pile
22010046-1	Bunker Sand (1-13-22)	10YR 7/2 Light Gray with Multi Colored Specks	None	2.5	-	-



Photomicrograph of Lab ID 22010046-1 Bunker Sand (1-13-22).

*ASTM F1632 Method B, Determination of Size Factors SOP, & Bunker Sand SOP

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

¹ USGA Green Section Record Volume 58, Issue 11, June 2020

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

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Sample condition upon receipt was normal.

Samples were received with a transmittal letter.

Reviewed by Sam Fero