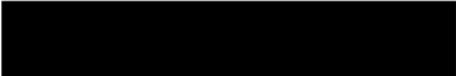


**YOUR<sup>TM</sup>  
ISTRC SYSTEM  
REPORT**

  
**COUNTRY CLUB**

April 7, 2021  
Green 8, 12, and 16  
Lab ID: 21030048

Presented to:



11372 Strang Line Road  
Lenexa, KS 66215



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April 7, 2021

[REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]

re: Lab ID: 21030048; ISTRC SYSTEM™ BenchMarking of undisturbed core sample from the Green #8 [center]; Green #12 [back & center]; Green #16 [center]. **ISTRC Rep:** Mr. Rob Larson / Tom Irwin, Inc.

Dear [REDACTED]

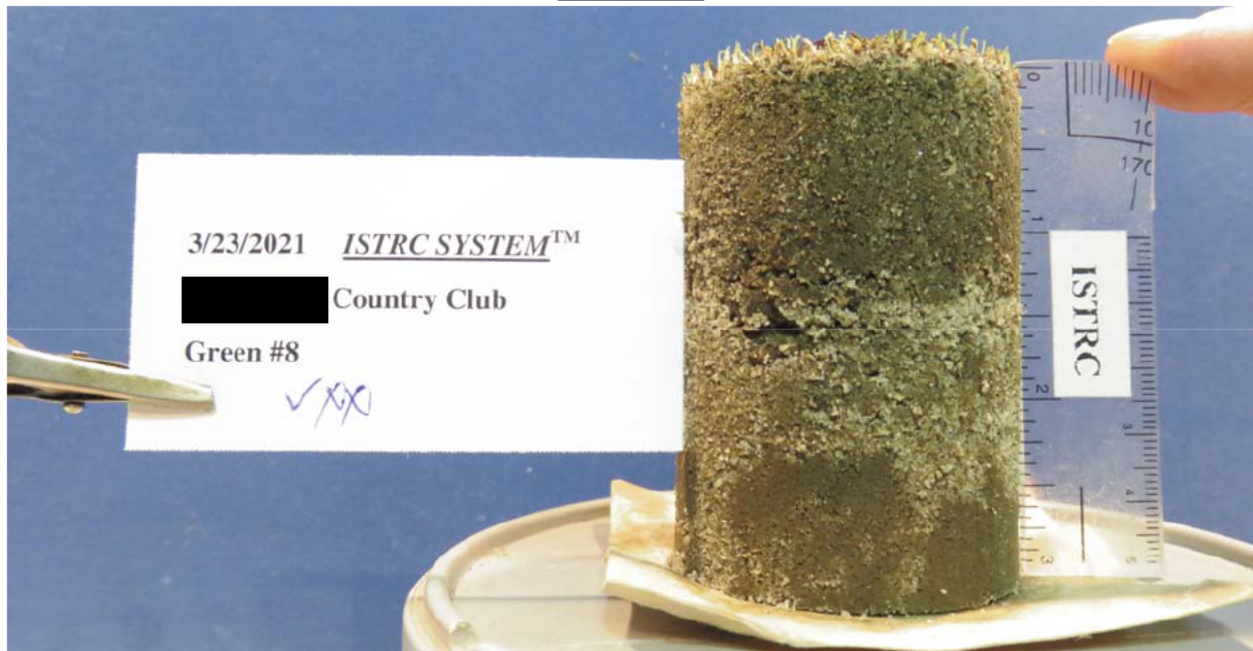
We have completed the ISTRC SYSTEM™ BenchMarking of the undisturbed core sample taken from Greens 8, 12 & 16.

The laboratory data can be found in its entirety at the end of this report. There are two sets of data. The first set of data consists of the physical evaluation, the evaluation of the root systems, and the measurement of the organic matter by layer. The second set of data contains the textural & particle size analysis. The textural analysis measures the percentage of gravel, sand, silt and clay comprising the soil. The particle size distribution analyzes the size distribution of the sand.

On the following page we will discuss the current test results. Included with the discussion is a selected time lapse photo of the root zone, our Target Table with the greens' physical properties, and an inch-by-inch analysis of the Textural & Sand Particle Size Distribution. Tables 1 - 3 compares the current test results to our recommended target range for well-drained, sand-based greens. The time lapse photo included on the following page was taken during the drying process of the greens and a selected photo has been included within the report to provide visual confirmation of the tested physical properties. As a general rule the darker the sample the higher the organic content & water holding properties.

This is the annual monitoring of the greens as well as the comparison for Green #12 to monitor how the expansion is progressing. We have included the past results for Green #12 in the report table to better illustrate any trends that are occurring within the green and our recommendations will be based on both the comparison index as well as the immediate results for the other greens to better serve the long term health of the greens.

## Green #8

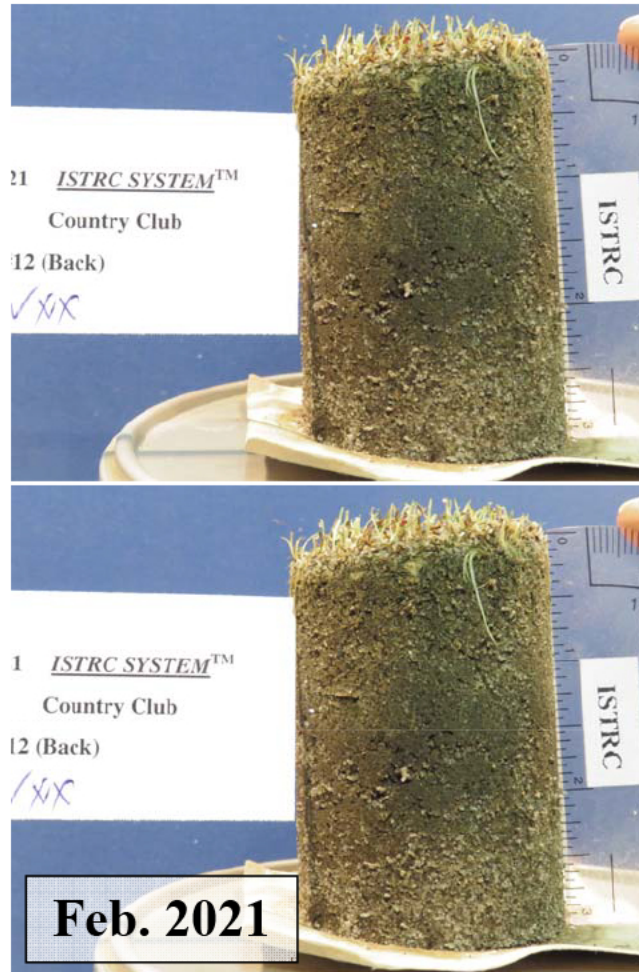


**Table 1.**

**ISTRC Target Ranges**

	<b>Green #8</b>	<b>Well-Drained Greens (1<sup>st</sup> tier Sample)</b>
<b>Infiltration Rate</b> [In/hr]	17.31 [fantastic; this ability is being fueled by the impressive air porosity of 20.32%; controlling the water holding will sustain this current reading]	At least 6
<b>Air Porosity</b> [Non-Capillary]	20.32% [great; the current water to air ratio sits within the 1:1 range and seems to be encouraging healthy permeability beyond the surface; we don't want to see this percentage decline beyond this point]	~20%
<b>Water Porosity</b> [Capillary]	28.61% [high; not too bad, especially when the air porosity is at 20.32%; the total porosity is fantastic at 48.94%, but we don't want to see the water pores rise without the air porosity going with it]	15% to 25%
<b>Bulk Density</b> [g/cc]	1.29 [low; traditionally a strong indication of heavy thatch, but the healthy total porosity appears to be able to compensate for it]	1.35 to 1.45
<b>Water Holding</b>	22.17% [high; the majority of the water holding appears to be at/near the surface with the thatch and organic matter; the profile is currently able to facilitate healthy permeability once the moisture breaches the top two inches]	10% to 20%
<b>Organic Content: 0-1"</b>	4.06% [high]	1.5% to 2.5%
<b>Organic Content: 1-2"</b>	2.33% [high]	1.0% to 2.0%
<b>Organic Content: 2-3"</b>	1.39% [good; within the target ranges]	0.5% to 2.0%
<b>Organic Content: 3-4"</b>	1.03% [good; within the target ranges]	0.5% to 1.5%
<b>Root Mass</b>	3/8 in. [ok]	at least ½ in.
<b>Feeder Roots</b>	Less than 3 in. [ok]	at least 3 ½ in. -med. density

## Green #12

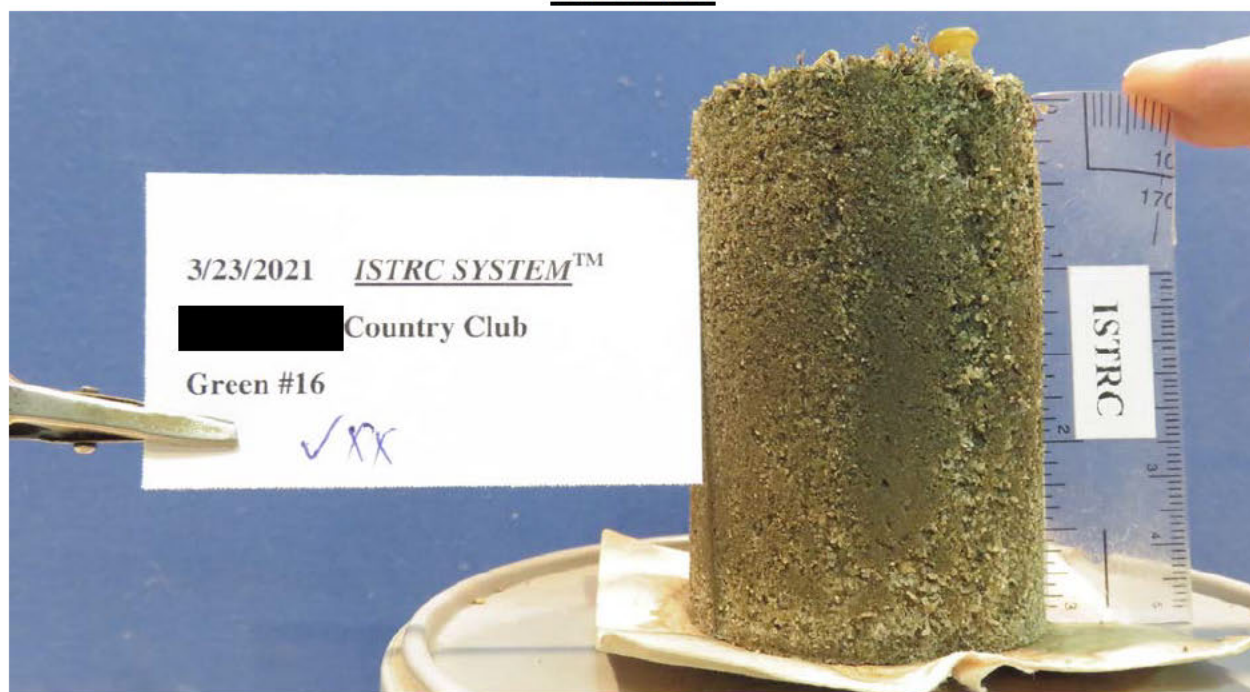


**Table 2.**

‘+’ improvement, ‘=’ no change, ‘-’ regressed

Green #12 1 <sup>st</sup> tier (0-4")	Well-Drained Greens (1 <sup>st</sup> tier Samples)	Comparison Index* +,=,-	March 2021		March 2020	March 2017
			Back	Center		
<b>Infiltration Rate</b> [In/hr]	At least 6	=	5.71	6.46	5.77	3.46
<b>Air Porosity</b> [Non-Capillary]	~20%	=	16.96%	14.09%	15.40%	14.48%
<b>Water Porosity</b> [Capillary]	15% to 25%	=	26.94%	29.07%	29.07%	28.38%
<b>Bulk Density</b> [g/cc]	~1.35 to 1.45	+	1.36	1.39	1.34	1.36
<b>Water Holding</b>	10% to 20%	+	19.88%	20.91%	21.73%	20.89%
<b>Organic Content: 0-1"</b>	1.5% to 2.5%	+	2.93%	3.81%	4.05%	3.75%
<b>Organic Content: 1-2"</b>	1.0% to 2.0%	=	2.09%	1.91%	2.00%	2.66%
<b>Organic Content: 2-3"</b>	0.5% to 2.0%	+	0.71%	1.42%	1.60%	1.36%
<b>Organic Content: 3-4"</b>	0.5% to 1.5%	=	0.62%	1.42%	1.40%	1.15%
<b>Root Mass</b>	at least ½ in.	=	3/8 in.	3/8 in.	3/8 in.	3/8 in.
<b>Feeder Roots</b>	at least 3.5 in. -med. density	=	Less than 3 in.	Less than 3 in.	<3 in.	<3 in.

## Green #16



**Table 3.**

**ISTRC Target Ranges**

	<b>Green #16</b>	<b>Well-Drained Greens (1<sup>st</sup> tier Sample)</b>
<b>Infiltration Rate</b> [In/hr]	3.27 [low; the profile is struggling to move moisture beyond the surface due to a lack of air porosities and the imbalance within the water to air ratio]	At least 6
<b>Air Porosity</b> [Non-Capillary]	8.68% [low; this percentage would be low if the water properties were controlled, but it is also exacerbated by the high water porosity of 33.25%; ideally, we'd like to see this percentage raised to the high teens over the next couple of seasons]	~20%
<b>Water Porosity</b> [Capillary]	33.25% [high; the water to air ratio is currently just under 4:1 and too imbalanced to sustain healthy permeability; transferring portions of these water pores back into air pores should be the target, while increasing the total porosity by roughly 5%]	15% to 25%
<b>Bulk Density</b> [g/cc]	1.44 [good; neither compaction nor thatch appear to be an issue for this green]	1.35 to 1.45
<b>Water Holding</b>	23.16% [high; the 6.09% organic reading for the top two inches is higher than we want to see and is directly influencing the elevated water holding ability; diminishing the build up should begin to lessen the water holding and lead to healthier permeability and breathability]	10% to 20%
<b>Organic Content: 0-1"</b>	3.92% [high]	1.5% to 2.5%
<b>Organic Content: 1-2"</b>	2.17% [high]	1.0% to 2.0%
<b>Organic Content: 2-3"</b>	1.44% [good; within the target range]	0.5% to 2.0%
<b>Organic Content: 3-4"</b>	1.29% [good; within the target range]	0.5% to 1.5%
<b>Root Mass</b>	3/8 in. [ok]	at least ½ in.
<b>Feeder Roots</b>	Less than 3 in. [ok]	at least 3 ½ in. -med. density

## Particle Distribution

	Textural Analysis				Sand Particle Size Distribution						
	Sand	Silt	Clay	Gravel	Very Coarse	Coarse	Medium	Medium	Med/Fine	Fine	Very Fine
USDA (mm)	.05 to 2.00	.002 to .05	<.002	2.00	1.00	0.50	0.25	0.18	0.15	0.10	0.05
U.S. Sieve (mesh)	270 to 18	(Pan)	(Pan)	10	18	35	60	80	100	140	270
SAMPLE NAME	% Retained on Sieve										
Green #8's 1 <sup>st</sup> tier	25 - 1 0 in	94.78	2.09	3.13	0.00	7.03	26.88	44.08	10.38	3.03	2.50
	1 0 - 2 0 in	97.68	0.93	1.39	0.00	7.45	24.75	46.33	11.95	3.45	2.75
	2 0 - 3 0 in	97.78	0.89	1.33	0.00	7.15	28.70	44.23	10.60	3.20	2.65
	3 0 - 4 0 in	93.95	1.96	2.94	1.15	2.50	28.80	42.30	10.38	3.50	2.85
G12-Back 1 <sup>st</sup> tier	25 - 1 0 in	97.18	1.13	1.69	0.00	7.65	29.05	42.80	10.45	3.28	2.75
	1 0 - 2 0 in	96.40	1.44	2.16	0.00	8.30	37.00	37.80	8.00	2.50	2.00
	2 0 - 3 0 in	97.38	1.05	1.57	0.00	4.70	38.15	38.63	8.95	2.95	2.75
	3 0 - 4 0 in	98.15	0.74	1.11	0.00	17.30	26.50	38.95	9.85	2.80	2.00
G12-Center 1 <sup>st</sup> tier	25 - 1 0 in	96.80	1.28	1.92	0.00	6.88	27.50	44.03	10.88	3.40	2.86
	1 0 - 2 0 in	96.48	1.41	2.11	0.00	6.25	28.38	46.50	9.50	2.65	2.25
	2 0 - 3 0 in	95.14	1.94	2.92	0.00	4.75	25.25	46.51	11.20	3.33	2.85
	3 0 - 4 0 in	91.94	2.76	4.15	1.15	8.33	21.10	37.08	12.55	4.88	5.00
Green #16's 1 <sup>st</sup> tier	25 - 1 0 in	95.10	1.96	2.94	0.00	7.75	29.70	39.53	9.35	3.38	3.74
	1 0 - 2 0 in	95.05	1.98	2.97	0.00	9.70	25.00	44.35	9.35	2.75	2.40
	2 0 - 3 0 in	95.65	1.59	2.38	0.38	7.05	28.20	45.00	9.20	2.65	2.35
	3 0 - 4 0 in	95.95	1.62	2.43	0.00	4.50	25.83	41.75	12.28	4.58	4.38
89 to 100		5 Max	3 Max	3 Max	10 Max	At least 60		20 Max		5 Max	
		10 Max w/ Fine & V.F.		10 Max						10 Max w/Silt & Clay	
89 to 100		5 Max.	3 Max.	3 Max.	10 Max.	15 to 25	40+	10 to 15	20 - #80	5 Max.	
		10 Max. w/ Fine & V.F.		10 Max.		65 to 85 Optimum				10 Max. w/Silt & Clay	

Above is the inch-by-inch analysis (upper 4") of the Textural & Sand Particle Size Distribution for Green #8's 1<sup>st</sup> tier, Green #12's [back & center] 1<sup>st</sup> tier and Green #16's 1<sup>st</sup> tier. A complete inch-by-inch analysis for the tested green is also attached to the end of the report. The lower box contains the USGA specifications & ISTRC Guidelines - the upper set is the USGA specifications, and the lower set is the expanded guidelines from ISTRC. The inch-by-inch breakdowns of the Textural & Sand Particle Size Distribution are comparable to our previous testing of the native soil greens.

The particle distributions continue to look impressive within the top three inches and reflect the use of a quality, USGA style topdressing sand. The older section of Green #12 and Green #16 do show elevated fines in the 3-to-4-inch depths and this is consistent with our previous analysis last year. These amounts will be difficult to amend and should be worked deeper into the profiles as the topdressing program amends the greens from the top, down over time.

## Summary

A general discussion on Maintenance Practices is contained in Section V of **The ISTRC Guidebook**. We encourage you to reference the Guidebook for a wide range of topics relating to the root zone, environmental factors, and maintenance.

We want to start by saying the expanded part of Green #12 is nearly perfect as the idea was to match the existing properties to have one, cohesive green that would respond uniformly to the cultural and nutritional program. The physical properties literally show a difference of 1 to 2

years of maturing between the two areas and the staff should be applauded for their efforts as the expansion should be viewed as a complete success in terms of the physical make-up of the area.

The properties show how related the amount of air pores and the water to air ratios are to encouraging and supporting healthy permeability beyond the surface. Green #8 has the highest amount of air porosities at 20.32%, along with the most balanced water to air ratio, close to 1:1. The other samples show profiles that are struggling to support enough oxygen for the plant to breathe and the air space to properly move moisture into the lower depths. These factors really force the program to be on the aggressive side in order to reestablish better balance for the long term health of the plant and immediate consistency on the surface for playability.

The previous recommendation to displace no less than 25% surface materials remains relevant and we have to acknowledge how difficult it might be to achieve this goal if the course is supporting a higher number of rounds, like the majority of our clients are. Therefore, some courses have gone to a more frequent, smaller tine approach to accomplish the target goal for displacement. This is only an option, but the use of smaller tines, such as ¼" hollows on a regular basis may be less invasive and nondisruptive to play than scheduling the traditionally larger hollow tine applications. Regardless, the profiles are showing a need for more oxygen and less water holding to extend the life of the greens and to provide firmer putting surfaces through balance and health.


Whichever approach the staff decides to pursue with displacement, the program needs to involve some form of venting on a regular basis until the profiles are able to support healthier permeability and breathability without the direct aid of sand channels being present. It's not that these greens shouldn't perform well, but we are concerned that they may not have the ability to provide wiggle room to thrive during adverse conditions or extreme bouts of rain that are known to hit your area in the spring. These applications should be set as deep as possible and be performed as often as possible, depending on climate and surface conditions.

We recommend that you continue to monitor your greens with regular testing. The information derived from regular testing will allow you to monitor the aging process of the greens, evaluate the effectiveness of the current cultural practices, modify the program based on hard data, make adjustments to the program to meet the individual needs of specific greens, and detect problems before they affect the health of the greens.

If you have any questions or need any additional information, we encourage you to give us a call. We are always available to answer questions and discuss ideas with you. Our service is not confined to analyzing undisturbed cores. We do not charge for telephone calls and we encourage our client superintendents to use us as a resource.

Sincerely,

**I.S.T.R.C.**

by:   
Eric J. Doherty, President

**I.S.T.R.C.**  
**"International Sports Turf Research Center, Inc."**

Page: 1

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**The I.S.T.R.C. System™**

Company:  
Name:  
Address:  
City, ST, Zip



Date 16-Mar-21  
LabID: 21030048  
ISTRC Rep. Tom Irwin Inc (Rob Larson)

**Physical Evaluation**

**ISTRC SYSTEM™ Core Analysis**

						Porosity		
		Infiltration Rate	40 cm	Bulk	Solids	Total	Capillary	Non-Capillary
LAB ID NO.		Rate	Water Holding	Density		Porosity	[Water Pores]	[Air Pores]
		in/hr	%	g/cc	%	%	%	%
21030048-G8	Green #8, Center	17.31	22.17	1.29	51.06	48.94	28.61	20.32
	Organic [ISTRC Walkley/Black] .25 to 1 in.	4.06%				Root Mass: 3/8"		
	Organic [ISTRC Walkley/Black] 1 to 2 in.	2.33%				Feeders: less than 3"		
	Organic [ISTRC Walkley/Black] 2 to 3 in.	1.39%						
	Organic [ISTRC Walkley/Black] 3 to 4 in.	1.03%						
21030048-G12	Green #12, Back	5.71	19.88	1.36	56.10	43.90	26.94	16.96
	Organic [ISTRC Walkley/Black] .25 to 1 in.	2.93%				Root Mass: 3/8"		
	Organic [ISTRC Walkley/Black] 1 to 2 in.	2.09%				Feeders: less than 3"		
	Organic [ISTRC Walkley/Black] 2 to 3 in.	0.71%						
	Organic [ISTRC Walkley/Black] 3 to 4 in.	0.62%						
21030048-G12	Green #12, Center	6.46	20.91	1.39	56.84	43.16	29.07	14.09
	Organic [ISTRC Walkley/Black] .25 to 1 in.	3.81%				Root Mass: 3/8"		
	Organic [ISTRC Walkley/Black] 1 to 2 in.	1.91%				Feeders: less than 3"		
	Organic [ISTRC Walkley/Black] 2 to 3 in.	1.42%						
	Organic [ISTRC Walkley/Black] 3 to 4 in.	1.42%						
21030048-G16	Green #16, Center	3.27	23.16	1.44	58.07	41.93	33.25	8.68
	Organic [ISTRC Walkley/Black] .25 to 1 in.	3.92%				Root Mass: 3/8"		
	Organic [ISTRC Walkley/Black] 1 to 2 in.	2.17%				Feeders: less than 3"		
	Organic [ISTRC Walkley/Black] 2 to 3 in.	1.44%						
	Organic [ISTRC Walkley/Black] 3 to 4 in.	1.29%						
	USGA Sample Range [Root Zone Mix]	at least 6	10 to 20	1.4 to 1.7	45 to 65	35 to 55	15 to 25	15 to 30

Reviewed by: EJD

**I.S.T.R.C.****International Sports Turf Research Center, Inc."**

Page: 1

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Company:

Name:

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City, ST, Zip

Date 16-Mar-21

LabID: 21030048

ISTR Rep. Tom Irwin Inc (Rob Larson)

		Textural Analysis				Sand Particle Size Distribution						
		Sand	Silt	Clay	Gravel	Very Coarse	Coarse	Medium	Medium	Med/Fine	Fine	Very Fine
		USDA (mm)	.05 to 2.00	.002 to .05	<.002	2.00	1.00	0.50	0.25	0.18	0.15	0.10
	U.S. Sieve (mesh)	270 to 18	(Pan)	(Pan)	10	18	35	60	80	100	140	270
LAB ID NO.	SAMPLE NAME											
21030048-G8	.25 - 1.0 in.	94.78	2.09	3.13	0.00	7.03	26.88	44.08	10.38	3.03	2.50	0.88
Green #8	1.0 - 2.0 in.	97.68	0.93	1.39	0.00	7.45	24.75	46.33	11.95	3.45	2.75	1.00
1st Tier	2.0 - 3.0 in.	97.78	0.89	1.33	0.00	7.15	28.70	44.23	10.60	3.20	2.65	1.25
Center	3.0 - 4.0 in.	93.95	1.96	2.94	1.15	2.50	28.80	42.30	10.38	3.50	3.62	2.85
21030048-G12	.25 - 1.0 in.	97.18	1.13	1.69	0.00	7.65	29.05	42.80	10.45	3.28	2.75	1.20
Green #12	1.0 - 2.0 in.	96.40	1.44	2.16	0.00	8.30	37.00	37.80	8.00	2.50	2.00	0.80
1st Tier	2.0 - 3.0 in.	97.38	1.05	1.57	0.00	4.70	38.15	38.63	8.95	2.95	2.75	1.25
Back	3.0 - 4.0 in.	98.15	0.74	1.11	0.00	17.30	26.50	38.95	9.85	2.80	2.00	0.75
21030048-G12	.25 - 1.0 in.	96.80	1.28	1.92	0.00	6.88	27.50	44.03	10.88	3.40	2.86	1.25
Green #12	1.0 - 2.0 in.	96.48	1.41	2.11	0.00	6.25	28.38	46.50	9.50	2.65	2.25	0.95
1st Tier	2.0 - 3.0 in.	95.14	1.94	2.92	0.00	4.75	25.25	46.51	11.20	3.33	2.85	1.25
Center	3.0 - 4.0 in.	91.94	2.76	4.15	1.15	8.33	21.10	37.08	12.55	4.88	5.00	3.00
21030048-G16	.25 - 1.0 in.	95.10	1.96	2.94	0.00	7.75	29.70	39.53	9.35	3.38	3.74	1.65
Green #16	1.0 - 2.0 in.	95.05	1.98	2.97	0.00	9.70	25.00	44.35	9.35	2.75	2.40	1.50
1st Tier	2.0 - 3.0 in.	95.65	1.59	2.38	0.38	7.05	28.20	45.00	9.20	2.65	2.35	1.20
Center	3.0 - 4.0 in.	95.95	1.62	2.43	0.00	4.50	25.83	41.75	12.28	4.58	4.38	2.63
USGA		89 to 100	5 Max.	3 Max.	3 Max.	10 Max.	At least 60		20 Max.		5 Max.	
Recommended Specifications			10 Max. w/ Fine & V. Fine		10 Max.						10 Max. w/ Silt & Clay	
ISTRC Guidelines		89 to 100	5 Max.	3 Max.	3 Max.	10 Max.	15 to 25	40+	10 to 15	5 to 10	5 Max.	
			10 Max. w/ Fine & V. Fine		10 Max.		65 - 75 Optimum		Cumulative < 20%		10 Max. w/ Silt & Clay	

Reviewed by: ESD

# ISTRC

## International Sports Turf Research Center

### Aerification Displacement Chart

Tine Size	1.25" x 1.25" Centers	1.5" x 1.5" Centers	2.0" x 2.0" Centers	2.5" x 2.5" Centers	5" x 5" Centers
1/4" Hollow Tines	3.14%	2.18%	1.23%	0.79%	
3/8" Hollow Tines	7.07%	4.91%	2.76%	1.77%	
1/2" Hollow Tines	12.57%	8.73%	4.91%	3.14%	
5/8" Hollow Tines		13.64%	7.67%	4.91%	
5/8" Hollow Vertidrain					1.23%
3/4" Hollow Tines				7.07%	1.77%
3/4" Hollow Vertidrain					1.77%
1" Hollow Tines					3.14%
1" Hollow Vertidrain					3.14%
7/8" Drill & Fill (7" Ctrs)					1.23%
Graden Verticutter (15 Blades @ 1" Spacings)	<u>1mm Blade</u> 3.93%	<u>2mm Blade</u> 7.87%	<u>3mm Blade</u> 11.81%		

Note: 1/4" Quadtines remove as much material as Regular 1/2" Hollow Tines

3/8" minimum for ease of topdressing fill if replacement of material is required

For double aerification make two passes at approx. 37° (slightly less than 45°) to minimize overlap

**International Sports Turf Research Center, Inc.**

**For Additional Information Please Call:**

**1-800-362-8873**

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**Or Visit Our Website At:**

**[www.istrc.com](http://www.istrc.com)**