


Pivot™ by TenCate Overview Test Report (1.5" Version)

Client(s) Name	Joe Fields Charles Dawson																																					
Client Detail	TenCate America 1131 Broadway St. Dayton, TN 37321																																					
Report Number	CTI.23-097B																																					
Revision Number & Date	1.1	December 19 th 2023																																				
Reported by	Dr C Young																																					
Approved by																																						
Scope of Testing / Project	<p>At the request of TenCate America a wide range of testing was undertaken on the Pivot™ turf system.</p> <p>Testing included the procedures commonly used both in the United States and European turf markets including identification, physical, chemical, and performance test methods.</p> <p>Testing was conducted to the relevant norms and specification outlined in the procedures below following the best practices outlined in ISO 17025.</p>																																					
Test Procedures & Standards	<p>The following testing has been undertaken on the TenCate Pivot™ turf system.</p> <p>Identification Tests</p> <table> <tr><td>ASTM D5793</td><td>Stitch and Gauge</td></tr> <tr><td>ISO 1763:2020</td><td>Tufts Per Unit Area</td></tr> <tr><td>ISO 2549:1972</td><td>Pile Length above Backing</td></tr> <tr><td>ASTM D5823</td><td>Pile Height</td></tr> <tr><td>ASTM D5848</td><td>Backing Weight, Pile Yarn Weight, and Total Weight</td></tr> <tr><td>ISO 8543:2020</td><td>Mass Per Unit Area and Total Pile Weight</td></tr> <tr><td>FIFA TM 0023</td><td>Decitex of yarn</td></tr> <tr><td>FIFA TM 0025</td><td>Yarn thickness</td></tr> <tr><td>ASTM D3218</td><td>Fiber Width and Thickness</td></tr> </table> <p>Physical Tests</p> <table> <tr><td>EN 12616:2013</td><td>Infiltration / Porosity</td></tr> <tr><td>ASTM D3385</td><td>Water Permeability</td></tr> <tr><td>EN 12230:2023</td><td>Tensile Strength</td></tr> <tr><td>ASTM D5034-09</td><td>Breaking Load (Grab Tear Strength)</td></tr> <tr><td>ISO 4919:2012</td><td>Tuft Withdrawal Force</td></tr> <tr><td>ASTM D1335</td><td>Tuft Bind</td></tr> <tr><td>EN 13746</td><td>Dimensional Stability (Water, Frost & Heated)</td></tr> </table> <p>Chemical Tests</p> <table> <tr><td>EN 12457-4</td><td>Leaching Heavy Metals</td></tr> <tr><td>ASTM F2765-14 (2021)</td><td>Total Lead Content in Synthetic Turf Fibres</td></tr> </table>		ASTM D5793	Stitch and Gauge	ISO 1763:2020	Tufts Per Unit Area	ISO 2549:1972	Pile Length above Backing	ASTM D5823	Pile Height	ASTM D5848	Backing Weight, Pile Yarn Weight, and Total Weight	ISO 8543:2020	Mass Per Unit Area and Total Pile Weight	FIFA TM 0023	Decitex of yarn	FIFA TM 0025	Yarn thickness	ASTM D3218	Fiber Width and Thickness	EN 12616:2013	Infiltration / Porosity	ASTM D3385	Water Permeability	EN 12230:2023	Tensile Strength	ASTM D5034-09	Breaking Load (Grab Tear Strength)	ISO 4919:2012	Tuft Withdrawal Force	ASTM D1335	Tuft Bind	EN 13746	Dimensional Stability (Water, Frost & Heated)	EN 12457-4	Leaching Heavy Metals	ASTM F2765-14 (2021)	Total Lead Content in Synthetic Turf Fibres
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	<p>DIN 38414-17 Extractable Organic Halides (EOX) Annex XVII No 1907/2006 PAHs (Polycyclic-Aromatic Hydrocarbons) GLI Procedure E9-1/E9-3 PFAS (Total Fluorine Content)</p> <p>Performance Tests</p> <table border="0"> <tr> <td>EN 12235 (FIFA TM001 & ASTM F1551)</td> <td>Ball Rebound Height</td> </tr> <tr> <td>EN 12234 (FIFA TM003)</td> <td>Ball Roll Distance</td> </tr> <tr> <td>EN 14808 (FIFA TM004A & ASTM F3189/F2569)</td> <td>Shock Absorption (AAA/AA)</td> </tr> <tr> <td>EN 14809 (FIFA TM005A & ASTM F3189/F2157)</td> <td>Vertical Deformation (AAA/AA)</td> </tr> <tr> <td>FIFA TM013</td> <td>Energy Restitution (AAA)</td> </tr> <tr> <td>ASTM F355-A</td> <td>Impact Attenuation (Gmax)</td> </tr> <tr> <td>EN 1177 & ASTM F355-E</td> <td>Critical Fall Height (HIC)</td> </tr> <tr> <td>EN 15301-1 (FIFA TM006 & ASTM F1551)</td> <td>Rotational Resistance</td> </tr> </table> <p>Wear / Sample Conditioning</p> <table border="0"> <tr> <td>EN 15306</td> <td>Exposure to Simulated Wear (LISport Classic)</td> </tr> <tr> <td>FIFA LISport XL</td> <td>Exposure to Simulated Wear (LISport XL)</td> </tr> <tr> <td>EN 12229</td> <td>Samples Preparation</td> </tr> <tr> <td>EN 13744</td> <td>Immersion in Hot Water</td> </tr> <tr> <td>EN 13817</td> <td>Exposure to Hot Air</td> </tr> <tr> <td>EN 14836</td> <td>Exposure to Artificial Weathering (UV)</td> </tr> </table> <p><i>Note: testing on the TenCate Pivot™ turf system was undertaken to a range of test methods covering the procedures and standards from the USA and European regions. Some of these methods have crossover in method but are reported separately for clarity and in the units relevant to the specific region / procedure.</i></p>	EN 12235 (FIFA TM001 & ASTM F1551)	Ball Rebound Height	EN 12234 (FIFA TM003)	Ball Roll Distance	EN 14808 (FIFA TM004A & ASTM F3189/F2569)	Shock Absorption (AAA/AA)	EN 14809 (FIFA TM005A & ASTM F3189/F2157)	Vertical Deformation (AAA/AA)	FIFA TM013	Energy Restitution (AAA)	ASTM F355-A	Impact Attenuation (Gmax)	EN 1177 & ASTM F355-E	Critical Fall Height (HIC)	EN 15301-1 (FIFA TM006 & ASTM F1551)	Rotational Resistance	EN 15306	Exposure to Simulated Wear (LISport Classic)	FIFA LISport XL	Exposure to Simulated Wear (LISport XL)	EN 12229	Samples Preparation	EN 13744	Immersion in Hot Water	EN 13817	Exposure to Hot Air	EN 14836	Exposure to Artificial Weathering (UV)
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<p>Product Details</p>	<p>The product tested was TenCate Pivot™</p> <p>The system is described in Appendix A from the specification sheet provided by the client.</p> <p>Note: the turf product was tested with a combination of shockpads for performance specifications which are outlined in the relevant results section to demonstrate the performance of Pivot™ as part of turf system.</p>																												
<p>Test Conditions</p>	<p>The test samples were tested at:</p> <p>23 ± 2 °C (73.4 ± 3.5 °F); and 50 ± 10 % relative humidity</p> <p>Samples were conditioned for a minimum of 24 hours prior to testing.</p> <p>In accordance with EN 15330-1 (and FIFA test protocol) samples were prepared for testing in different conditions as below:</p> <p>Irrigated / wet samples (mass of water equal to mass of system applied) Heated to 50°C (122°F) Cooled to -5°C (23°F)</p> <p>Preparation of samples were undertaken in accordance with EN 12229</p>																												

Test Results	<p>The results are presented in Appendices as below:</p> <p>Appendix B: Identification Tests Appendix C: Physical Tests Appendix D: Chemical Tests Appendix E: Performance Tests</p>
Discussion & Conclusions	<p>The TenCate Pivot™ turf system has been tested to a comprehensive range of standards covering identification, physical, chemical and performance criteria.</p> <p>The report outlines the results of the testing to provide TenCate with the required information for their clients to make an informed decision on the turf product.</p> <p>Additional testing can be undertaken upon request including bespoke relationships to norms and requirements if needed.</p>

Appendix A – Pivot™ Specification Sheet (1.5" version)



No Infill. No Microplastics. No PFAS.

Pivot™ by Tencate is a true game changer. Designed with extensive feedback from top-level athletes, Pivot™ by Tencate provides ultimate performance, maximum player comfort and ultra-durability.

The unique combination of yarns plays and responds like the best natural grass and will perform at Year 10 like it does on Day 1. Additionally, Pivot™ by Tencate is the environmentally-friendly choice – no infill is needed and real-grass feel is achieved without any resource intensive maintenance.

 **TENCATE**

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Appendix A – Pivot™ Specification Sheet (1.5" version)

PIVOT™ BY TENCATE 1.5" SPECS



YARN

DENSITY (DENIER)	5,040/1 (XP+); 5,400/6 (semi-TXT); 7,200/10 (TXT)
THICKNESS (MICRONS)	100 (XP+); 152 (semi-TXT); 145 (TXT)
MELTING POINT	128° C 260° F
BREAKING STRENGTH	11 lbs/force (XP+); 20 lbs/force (semi-TXT); 20 lbs/force (TXT)
LEAD CONTENT (PPM)	<100



PILE CONTENT



BLEND OF DURABLE SLIT FILM AND SEMI-TEXTURIZED AND TEXTURIZED MONOFILAMENT FIBERS

TenCate XP+ U.V. resistant slit film, combined with TenCate semi-TXT and TXT monofilament root zone.

PRIMARY BACKING	7.5 oz/yd ² ; TenCate K29 Backing (Double Layer Thiobac, black, U.V. stabilized, Layer 1: 100% PP, Layer 2: PET/PP blend)
SECONDARY BACKING	20 oz/yd ² Polyurethane coating with drainage holes
TOTAL WEIGHT	147.5 oz/yd ²
PILE HEIGHT	1 1/2 inch
FACE WEIGHT*	120 oz/yd ²
MACHINE GAUGE	3/8 inch
SET UP	3 ends/needle
ROLL WIDTH	182 inch
WATER PERMEABILITY	64 inches/hour (unfilled)
TUFT BIND (ASTM D1335)	> 9 lbs
GRAB TEAR (ASTM D5034)	274 lbs length, 395 lbs width
PILL FLAMMABILITY (ASTM D2859)	Pass



BEST FOR FOOTBALL, SOCCER,
BASEBALL, INDOOR
AND MULTI-PURPOSE FIELDS



Pile Height, Max Thickness, Face Weight, Primary & Secondary Backing, and Total Weight can differ by ±10%. The Stitch Rate will change according to the exact specifications and can differ by ±1. Roll Width can differ by ±0.8 inch.

TenCate has the right to alter each product specification in order to improve the system according to the latest standards. TenCate is not legally liable in case of noncompliance with the above mentioned specifications.

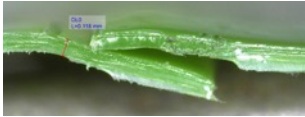
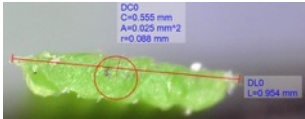
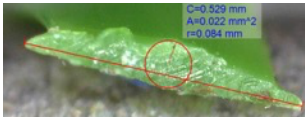
*Face Weight reflects entire length of yarn, including portion woven into backing, which is consistent with standard ASTM method of measuring tuft including back stitch.

TENCATE AMERICAS | 1131 BROADWAY ST. DAYTON, TN 37321 | (855) 773-6668 | TENCATEGRASS.COM | VERSION 2024

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Appendix B – Test Results: Identification

Turf				
Test Method	Unit	Description	Result	Comment
ASTM D5793	in"	gauge	3/8	-
	# / in"	stitch rate	5.33	-
ISO 1763	# / sq m	tufts per unit area	22,000	metric
	# / sq yd	tufts per unit area	18,395	imperial (yd)
	# / sq ft	tufts per unit area	2,050	imperial (ft)
ISO 2549	mm	pile length	38	metric
ASTM D5823	in"	pile length	1.5	imperial
ISO 8543	g / sq m	total system mass	4,985	metric
	g / sq m	pile mass	3,925	metric
	g / sq m	primary backing mass	251	metric
	g / sq m	secondary coating mass	749	metric
ASTM D5848	oz / sq yd	total system mass	150	imperial
	oz / sq yd	pile mass	119	imperial
	oz / sq yd	primary backing mass	7.5	imperial
	oz / sq yd	secondary coating mass	22.5	imperial
Yarn(s)				
Test Method	Unit	Description	Result	Comment
ASTM D3218 FIFA TM 0025	microns (μm)		101	yarn A XP (5,040/1)
	microns (μm)		153	yarn B Semi TxT (5,400/6)
	microns (μm)		144	yarn C TxT (7,200/10)
FIFA TM 0023	Dtex	decitex of yarn	XP – 5,110/1 Semi TxT – 5,511/6 TxT – 7,151/10	denier is circa 10 % lower than Dtex

Appendix C – Test Results: Physical Properties

Test Method	Unit	Description	Result	Comment
EN 12616	mm/h	falling head infiltration test	> 3,000	metric
ASTM D3385	in"/h	falling head infiltration test	> 100	imperial
EN 12230	N / mm	tensile strength – MD	32	metric
		tensile strength - CD	40	metric
ASTM D5034-09	lbs	grab tear – MD	286	imperial
		grab tear - CD	401	imperial
ISO 4919	N	tuft bind	45	metric – target 30
	N	tuft bind after water age	44	metric – target 30
	%	% change	97	> 75 %
ASTM D1335	lbs	tuft bind	10.2	imperial
EN 13746	%	shrinkage (water, frost & heat)	< 0.05	requirement < 1 %
	%	extension (water, frost & heat)	< 0.05	

Appendix D – Test Results: Chemical

Test Method	Unit	Description	Result	Comment
EN 12457-4 / ISO 11885	mg / kg	compliance test for leaching - metals	lead (Pb) < 0.005 cadmium (Cd) < 0.001 chromium (Cr) < 0.002 tin (Sn) < 0.005 zinc < 0.005 DOC < 0.001 mercury (Hg) < 0.00001	none-detectable
ASTM F2765-14	ppm	total lead content in synthetic turf fibres	> 100	none-detectable
DIN 38414-17	mg / kg	extractable organic halides (EOX)	< 20	none-detectable allowable limit is < 100 mg/kg
Annex XVII No 1907/2006	mg / kg	PAHs (polycyclic-aromatic hydrocarbons)	< 0.2 for each 18 PAHs	none-detectable allowable limits is < 20 mg/kg
GLI Procedure E9-1/E9-3	PPM	PFAS	a09: Fluoride < 0.5 ppm F: Fluorine < 10 ppm r19: Organic Fluorine < 10 ppm	None-detectable

Notes:

Test values often are not reported as zero the test method is only accurate enough to stipulate a 'less than' result. This value can be different for each specific substance or test method.

TenCate Pivot™ has been declared compliant with requirements of REACH within the European Union and EPA / Prop 65 criteria in the United States.

Appendix D – Test Results: Performance

Test Method (unit)	Sample Conditioning	FIFA Quality Range	Surface Combination			
			TenCate Pivot™ (no pad)	TenCate Pivot™ GeoFlo (15 mm)	TenCate Pivot™ GeoFlo+ (15 mm)	TenCate Pivot™ GeoFlo+ (20 mm)
AAA (%) Shock Absorbency EN 14808 FIFA TM004A ASTM F3189/F2569	Dry	55 to 70	58	61	63	66
	Wet		58	62	64	67
	50°C		59	62	65	68
	-5°C		57	60	63	64
	LISport Wear Classic		56	61	64	65
	LISport Wear XL		57	61	63	65
AAA (mm) Vertical Deformation EN 14809 FIFA TM005A ASTM F3189/F2157	Dry	4 to 11	8.1	8.5	9.3	9.5
	Wet		8.2	8.6	9.4	9.6
	50°C		8.3	8.5	9.5	9.7
	-5°C		8.1	8.7	9.3	9.5
	LISport Wear Classic		8.0	8.4	9.3	9.9
	LISport Wear XL		8.0	8.3	9.2	10.0
AAA (%) Energy Restitution FIFA TM013	Dry	20 to 50 (not pass/fail)	32	31	29	28
	Wet		32	30	28	27
	50°C		33	32	29	27
	-5°C		32	32	30	26
	LISport Wear Classic		35	34	30	29
	LISport Wear XL		35	33	31	29
Rotational Resistance (Nm) Grip EN 15301-1 FIFA TM006 ASTM F1551	Dry	25 to 50	32			
	Wet		30			
	50°C		31			
	-5°C		30			
	LISport Wear Classic		38			
	LISport Wear XL		39			
Impact Attenuation Gmax (g) ASTM F355-A	Dry	n/a FIFA < 200 ASTM < 165 STC < 150 NFL	137	98	84	77
	Wet		139	99	82	75
	50°C		139	98	78	77
	-5°C		141	100	86	78
	LISport Wear Classic		142	99	85	81
	LISport Wear XL		144	101	86	83
Critical Fall Height HIC (m) EN 1177 ASTM F355-E	Dry	n/a FIFA ≥ 1.3 WR	1.1	1.2	1.4	1.6
	Wet		1.1	1.2	1.4	1.6
	50°C		1.1	1.2	1.4	1.6
	-5°C		1.0	1.1	1.4	1.5
	LISport Wear Classic		1.0	1.2	1.4	1.6
	LISport Wear XL		1.1	1.2	1.4	1.6
Ball Rebound Height (m) EN 12235 FIFA TM001 ASTM F1551	Dry	0.6 to 1.0	0.71	0.67	0.67	0.68
	Wet		0.72	0.66	0.69	0.70
	50°C		0.73	0.69	0.71	0.72
	-5°C		0.71	0.71	0.72	0.72
	LISport Wear Classic		0.76	0.73	0.72	0.73
	LISport Wear XL		0.78	0.74	0.73	0.72
Ball Roll Distance (m) EN 12234 FIFA TM003	Dry	4 to 10	6.5			
	Wet		6.8			
	LISport Wear XL		7.9			

Appendix E – Pivot™ Product Photographs

