TECHNICAL REPORT

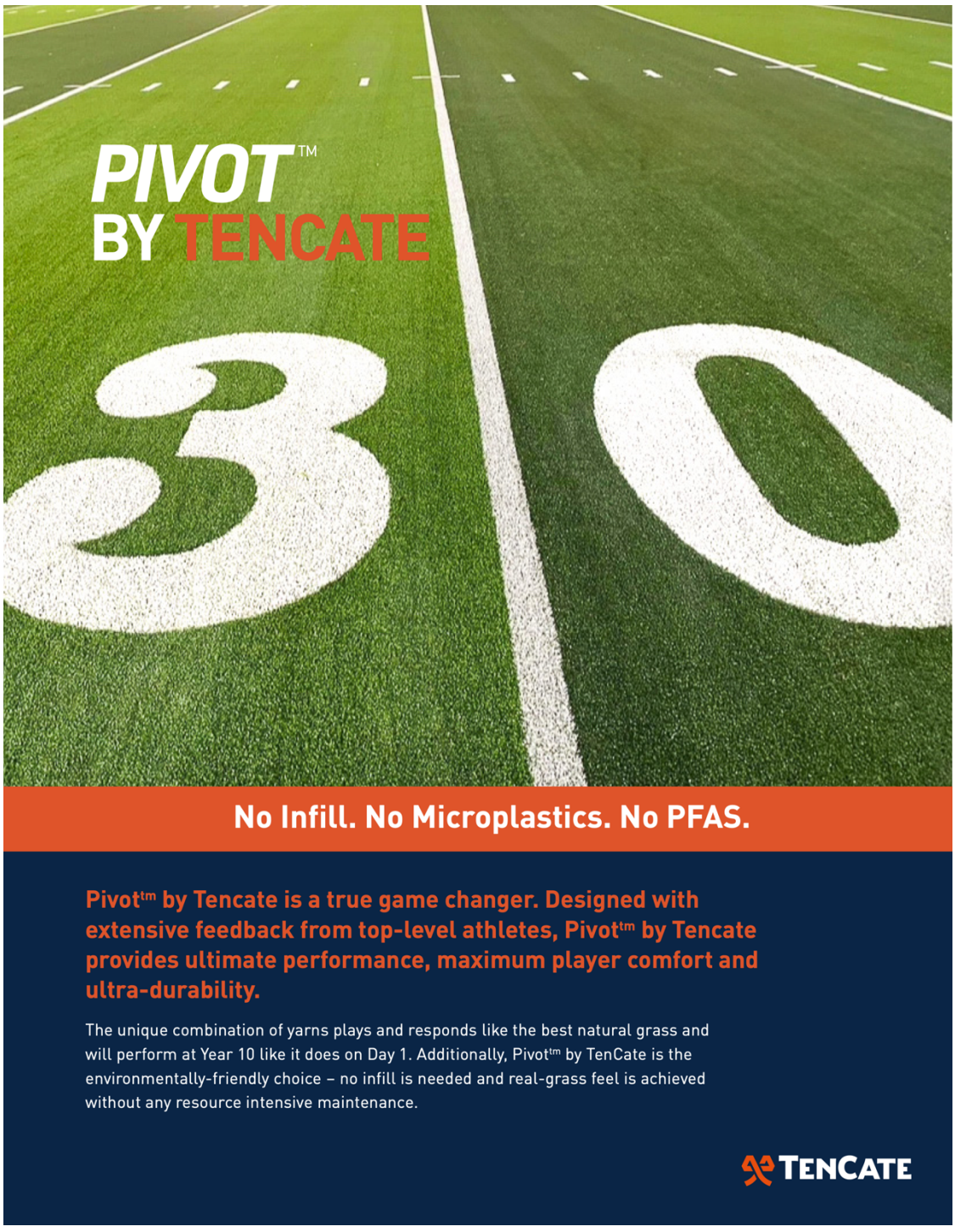
CENTER FOR TURF INNOVATION
POWERED BY TENCATE

Pivot™ by TenCate Overview Test Report (1.125" Version)		
Client(s) Name	Joe Fields Charles Dawson	
Client Detail	TenCate America 1131 Broadway St. Dayton, TN 37321	
Report Number	CTI.23-097D	
Revision Number & Date	1.1	December 19th 2023
Reported by	Dr C Young	
Approved by		
Scope of Testing / Project	At the request of TenCate America a wide range of testing was undertaken on the Pivot™ turf system. Testing included the procedures commonly used both in the United States and European turf markets including identification, physical, chemical, and performance test methods. Testing was conducted to the relevant norms and specification outlined in the procedures below following the best practices outlined in ISO 17025.	
Test Procedures & Standards	The following testing has been undertaken on the TenCate Pivot™ turf system. **Identification Tests** 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 **Physical Tests** 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) **Chemical Tests** EN 12457-4 — Leaching Heavy Metals ASTM F2765-14 (2021) — Total Lead Content in Synthetic Turf Fibres	

	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) **Performance Tests** 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 **Wear / Sample Conditioning** 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) *Note: testing on the TenCate Pivot™ turf system was undertaken to a range of test methods coving 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.*
Product Details	The product tested was TenCate Pivot™ The system is described in Appendix A from the specification sheet provided by the client. 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.
Test Conditions	The test samples were tested at: 23 ± 2 °C (73.4 ± 3.5 °F); and 50 ± 10 % relative humidity Samples were conditioned for a minimum of 24 hours prior to testing. In accordance with EN 15330-1 (and FIFA test protocol) samples were prepared for testing in different conditions as below: Irrigated / wet samples (mass of water equal to mass of system applied) Heated to 50°C (122°F) Cooled to -5°C (23°F) Preparation of samples were undertaken in accordance with EN 12229

Test Results	The results are presented in Appendices as below: Appendix B: Identification Tests Appendix C: Physical Tests Appendix D: Chemical Tests Appendix E: Performance Tests
Discussion & Conclusions	The TenCate Pivot™ turf system has been tested to a comprehensive range of standards covering identification, physical, chemical and performance criteria. 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. Additional testing can be undertaken upon request including bespoke relationships to norms and requirements if needed.

Appendix A – Pivot™ Specification Sheet (1.125" version)

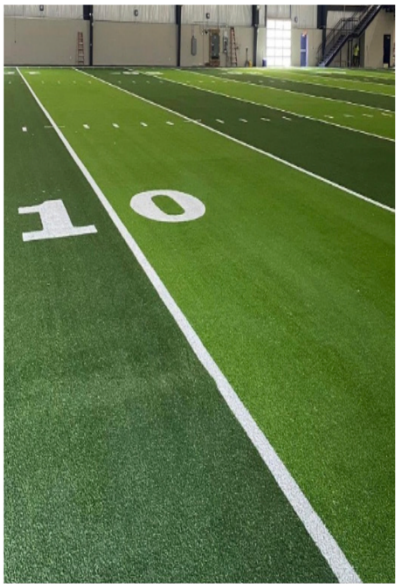


Appendix A – Pivot™ Specification Sheet (1.125" version)

PIVOT™ BY TENCATE 1.125" SPECS

TENCATE

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	TenCate XP+ U.V. resistant slit film, combined with TenCate semi-TXT and TXT monofilament root zone.
PRIMARY BACKING	7.5 oz/yd²; TenCate K29 Backing (Double Layer Thiobac, black, U.V. stabilized, Layer 1: 100% PP, Layer 2: PET/PP blend)
SECONDARY BACKING	20 oz/yd² Polyurethane coating with drainage holes
TOTAL WEIGHT	117.5 oz/yd²
PILE HEIGHT	1 1/8 inch
FACE WEIGHT*	90 oz/yd²
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

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

WARRANTY 10 YEARS WARRANTY

BEST FOR SOFTBALL, BASEBALL AND WARNING TRACKS.

MADE IN THE USA

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.

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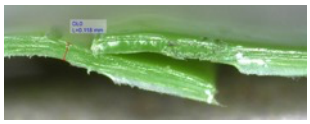
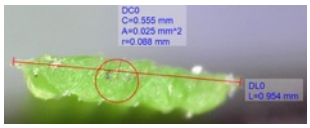
Appendix B – Test Results: Identification

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	28.58 (29)	metric
ASTM D5823	in″	pile length	1.125 (1 1/8)	imperial
ISO 8543	g / sq m	total system mass	4,000	metric
	g / sq m	pile mass	2,750	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	120	imperial
	oz / sq yd	pile mass	90	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	46	metric – target 30
	N	tuft bind after water age	45	metric – target 30
	%	% change	98	> 75 %
ASTM D1335	lbs	tuft bind	10.5	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 complaint 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	52	60	61	64
	Wet		51	59	62	65
	50°C		52	58	62	65
	-5°C		52	60	61	63
	LISport Wear Classic		51	57	59	62
	LISport Wear XL		50	58	60	63
AAA (mm) Vertical Deformation EN 14809 FIFA TM005A ASTM F3189/F2157	Dry	4 to 11	7.5	8.1	8.5	9.1
	Wet		7.4	8.1	8.7	9.2
	50°C		7.3	8.0	8.8	9.1
	-5°C		7.5	8.2	8.7	9.2
	LISport Wear Classic		7.2	7.9	8.5	9.0
	LISport Wear XL		7.2	7.9	8.6	8.9
AAA (%) Energy Restitution FIFA TM013	Dry	20 to 50 (not pass/fail)	33	33	32	35
	Wet		34	35	30	34
	50°C		33	33	31	34
	-5°C		34	34	32	36
	LISport Wear Classic		37	35	35	32
	LISport Wear XL		37	34	34	34
Rotational Resistance (Nm) Grip EN 15301-1 FIFA TM006 ASTM F1551	Dry	25 to 50	30			
	Wet		29			
	50°C		28			
	-5°C		27			
	LISport Wear Classic		34			
	LISport Wear XL		36			
Impact Attenuation Gmax (g) ASTM F355-A	Dry	n/a FIFA < 200 ASTM < 165 STC < 150 NFL	157	121	103	89
	Wet		162	122	105	85
	50°C		164	126	106	87
	-5°C		168	127	108	88
	LISport Wear Classic		172	131	116	94
	LISport Wear XL		176	134	112	98
Critical Fall Height HIC (m) EN 1177 ASTM F355-E	Dry	n/a FIFA ≥ 1.3 WR	0.8	1.0	1.2	1.4
	Wet		0.8	1.0	1.2	1.4
	50°C		0.8	1.0	1.2	1.4
	-5°C		0.8	1.0	1.3	1.4
	LISport Wear Classic		0.8	0.9	1.2	1.4
	LISport Wear XL		0.7	1.0	1.1	1.4
Ball Rebound Height (m) EN 12235 FIFA TM001 ASTM F1551	Dry	0.6 to 1.0	0.76	0.74	0.71	0.69
	Wet		0.78	0.73	0.72	0.69
	50°C		0.76	0.73	0.73	0.70
	-5°C		0.78	0.72	0.70	0.70
	LISport Wear Classic		0.81	0.71	0.76	0.75
	LISport Wear XL		0.83	0.76	0.75	0.75
Ball Roll Distance (m) EN 12234 FIFA TM003	Dry	4 to 10	6.4			
	Wet		6.6			
	LISport Wear XL		7.6			

Appendix E – Pivot™ Product Photographs