



### CLIENT:

Company:	Rubber Recycle
Address:	1985 Rutgers University Blvd
	Lakewood, NJ 08107

### TEST MATERIAL:

Date Material Received:	September 19, 2022
Material Type:	Loose Fill Rubber Mulch Nugget
Material Condition:	Excellent, New
Material ID:	Playsafer
Compacted Depth:	3"

### TESTING METHODS REQUESTED:

Testing Services, Inc was instructed by the client to perform the following testing:			
Standard:	ASTM F1951-21	Test Method:	Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment

### SAMPLING PLAN:

Sampling Date:	9/20/22
<ul style="list-style-type: none"> <li>Specimen sampling is performed in the sampling department at TSI.</li> <li>The sampling size of specimens is determined by the test method requirements.</li> <li>In the event a specific sampling size is not called for, a determination will be made based on previous testing experience, and approved for use by an authorized manager.</li> <li>All samples are subjected to the outside environmental conditions of temperature and relative humidity.</li> <li>Sample requiring pre-determined exposure to specified environmental conditions based on a specific test method, take place in the departments in which they are tested</li> </ul>	

### DEVIATION FROM TEST METHOD:

State reason for any Deviation from, Additions to, or Exclusions from Test Method:	
none	

### REQUIREMENT:

A surface in place shall have average work per foot (work per meter) values for straight propulsion and for turning less than the average work per foot (work per meter) values for straight propulsion and for turning, respectively, on a hard, smooth, surface with a grade of 1:14 (7.1 %).

### PROCEDURE:

**Test Surface Preparation:** Tests were conducted on 9/20/22 indoors at TSi Laboratories in an environment of 86°F and 44% R.H. The rubber nuggets were installed in a wooden box (44"W x 117"L) using a combination of a Brinly 18" X 24" water-filled lawn roller, filled with 28 gallons of water, and a 6 ½ HP plate compactor, used to compact the nuggets in 1" interval depths, **repeated until a final compacted depth of 3" was achieved.** One final roll was made with the Brinly lawn roller at the final compaction depth to simulate foot traffic.

**Wheelchair/Operator:** The wheelchair used in these tests was manufactured by Invcare, Model Action Xtra, Serial Number 98J84142. This wheelchair is totally adjustable, a necessity for these tests. The pneumatic tires were inflated to 60 psi on the rear and 32 psi on the front. The weight of the wheelchair was 24.25 pounds and the operator's weight was 165 pounds for a total of 189 pounds. The operator's distribution was adjusted to 60% on the rear wheels and 40 % on the front.

**Torque Measuring System:** A certified Mecmesin Advanced Force Gauge, Model 500N, was used as an interface between a Dell Laptop and a calibrated Smart Torque Wrench, S/N 97-0085-01. Emperor Lite Software, from Mecmesin, logged the load vs. time and integrated the area under the resulting curves. The adapters and accessories needed to attach the instrumentation were fabricated locally. This total package added 10 pounds to the total weight bringing the total to 199 pounds.



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## TEST SUMMARY:

TEST METHOD	Maximum Requirements – Average Work/ft-Force	TEST RESULTS – Average Work/ft-Force
ASTM F1951-21	Baseline Straight: 15.47 lbs	12.39 lbs
	Baseline Turning: 10.42 lbs	7.18 lbs

Straight Propulsion	1	2	3	4	5
Circumference of Rear Wheel	75.375"	75.375"	75.375"	75.375"	75.375"
Area	47.6279 ft <sup>2</sup> lbs*s	45.0157 ft <sup>2</sup> lbs*s	45.0770 ft <sup>2</sup> lbs*s	56.5539 ft <sup>2</sup> lbs*s	49.9326 ft <sup>2</sup> lbs*s
Time	7.30 seconds	7.75 seconds	7.90 seconds	7.70 seconds	8.00 seconds
Distance	86.0 inches	86.0 inches	86.0 inches	86.0 inches	86.0 inches
Distance	7.17 ft	7.17 ft	7.17 ft	7.17 ft	7.17 ft
Angular Displacement (radians)	7.17 rad	7.17 rad	7.17 rad	7.17 rad	7.17 rad
Average Torque (energy)	6.52 inches	5.81 inches	5.71 inches	7.34 inches	6.24 inches
Total Work (energy)	93.54 ft-lbs	83.28 ft-lbs	81.81 ft-lbs	105.31 ft-lbs	89.49 ft-lbs
Work/ft (force)	13.05 lbs	11.62 lbs	11.42 lbs	14.69 lbs	12.49 lbs
Drop Hi/Low Work/ft (force)	13.05 lbs	11.62 lbs			12.49 lbs
Average Work/ft (force)	12.39 lbs				

Turning Propulsion	1	2	3	4	5
Circumference of Rear Wheel	75.375"	75.375"	75.375"	75.375"	75.375"
Distance from Pivot Point to Outer Wheel	35.75 inches	35.75 inches	35.75 inches	35.75 inches	35.75 inches
Area	67.7001 ft <sup>2</sup> lbs*s	56.6229 ft <sup>2</sup> lbs*s	48.3188 ft <sup>2</sup> lbs*s	47.8154 ft <sup>2</sup> lbs*s	54.1464 ft <sup>2</sup> lbs*s
Time	7.50 seconds	7.00 seconds	7.25 seconds	7.95 seconds	8.00 seconds
Angle Traveled (degrees)	93.0°	93.0°	93.0°	93.0°	93.0°
Angle Traveled (radians)	1.62 rad	1.62 rad	1.62 rad	1.62 rad	1.62 rad
Arc Length Traveled by Outer Wheel	58.03 inches	58.03 inches	58.03 inches	58.03 inches	58.03 inches
Arc Length Traveled by Outer Wheel	4.84 ft	4.84 ft	4.84 ft	4.84 ft	4.84 ft
Angular Displacement of Outer Wheel (radians)	4.84 rad	4.84 rad	4.84 rad	4.84 rad	4.84 rad
Average Torque (energy)	9.03 ft lbs	8.09 ft lbs	6.66 ft lbs	6.01 ft lbs	6.77 ft lbs
Total Work (energy)	43.66 ft lbs	39.13 ft lbs	32.24 ft lbs	29.09 ft lbs	32.74 ft lbs
Work/ft (force)	9.03 lbs	8.09 lbs	6.67 lbs	6.02 lbs	6.77 lbs
Drop Hi/Low Work/ft (force)		8.09 lbs	6.67 lbs		6.77 lbs
Average Work/ft (force)	7.18 lbs				

## CONCLUSION:

The above listed material meets/exceeds both the straight line and turning propulsion requirements in accordance with ASTM F1951, where the surface tested average work per foot value was less than the average work per foot value verses a hard, smooth surface with a grade of 7.1%

## Uncertainty:

We undertake all assignments for our clients on a best effort basis. Our findings and judgments are based on the information to us using the latest test methods available. TSI can only ensure the test results for the specific items tested. Unless otherwise noted in the deviations sections of this report, all tests are performed in compliance with stated test method.

## Test Report Approval:

Erle Miles, III, Lab Director Testing Services (TSI) LLC

## TSI Accreditation:

Our laboratory is accredited by the US Dept. of Commerce, National Institute of Standards and Technology: ISO/IEC 17025:2005. Our code # is: NVLAP 100108-0. TSI is an Organizational Member of ASTM (American Society for Testing and Materials). TSI is a certified independent testing laboratory by the STC (Synthetic Turf Council).

