



## TEST REPORT

**CLIENT:**

|               |                                    |                       |           |
|---------------|------------------------------------|-----------------------|-----------|
| Company:      | Flex Fiber, LLC                    | Report Number:        | 79929     |
| Address:      | 1606 4 <sup>th</sup> Avenue, Ste B | Lab Test Number:      | 3182-2937 |
|               | Fargo, ND 58078                    | Test Completion Date: | 3/9/2020  |
|               |                                    | Report Date:          | 3/11/2020 |
| Requested By: | Zach Fluto                         | Page:                 | 1 of 2    |

**TEST MATERIAL:**

|                          |                          |     |       |                |           |
|--------------------------|--------------------------|-----|-------|----------------|-----------|
| Material Type:           | Loose Fill Wood Material |     |       | Date Received: | 2/25/2020 |
| Material Condition:      | EXCELLENT:               | XXX | GOOD: | POOR:          | REJECTED: |
| Material Identification: | Flex Fiber               |     |       |                |           |
| Test Depth:              | 9" Compacted             |     |       |                |           |

**TESTING METHODS REQUESTED:**

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

**SAMPLING PLAN:**

|  |           |
|--|-----------|
| Sampling Date:   | 2/25/2020 |
| <ul style="list-style-type: none"> <li>Flex Fiber, LLC delivered in excess of 100 cubic feet of loose fill wood material identified as "Flex Fiber" to our facility.</li> <li>Random sampling of the loose fill wood material lot submitted was used to fill the appropriate test area per the ASTM F1951 requirements.</li> </ul> |           |

**DEVIATION FROM TEST METHOD:**

|   |  |
|---|--|
| <b>State reason for any Deviation from, Additions to, or Exclusions From Test Method.</b> |  |
| 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 3/9/2020 outdoors at TSi Laboratories in an environment of 59°F and 51% R.H. The loose fill wood material was installed in a wooden frame (44"W x 117"L). Approximately 2 inches of the material was installed, thoroughly saturated with water, and compacted using a vibrating plate compactor. Additional material, saturating and compacting was repeated in this manner until a final compacted depth of 9" was achieved. Moisture content at time of test was 69%.

**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.

**TEST SUMMARY:**

| TEST METHOD   | Propulsion | Maximum Requirements – Baseline (No Material) |                                | TEST RESULTS – With Test Material |                                |
|---------------|------------|---|--------------------------------|-----------------------------------|--------------------------------|
|               |            | Average Work/ft-Force                         | Average Work/ft-Force (lbf-in) | Average Work/ft-Force             | Average Work/ft-Force (lbf-in) |
| ASTM F1951-14 | Straight   | 13.54 lbs                                     | 162.48 lbf-in                  | 13.29 lbs                         | 159.48 lbf-in                  |
|               | Turning    | 9.45 lbs                                      | 113.40 lbf-in                  | 8.64 lbs                          | 103.68 lbf-in                  |

*Individual data for all straight and turning propulsion tests are show on page 2 of this report.*

**CONCLUSION:**

The above listed material **meets/exceeds** both the straight line and turning propulsion requirements set forth in this test, 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 performed are in compliance with stated test method.

Test Report Approval:

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

OUR LETTERS AND REPORTS APPLY ONLY TO THE SAMPLE TESTED AND ARE NOT NECESSARILY INDICATIVE OF THE QUALITIES OF APPARENTLY IDENTICAL OR SIMILAR PRODUCTS. THESE LETTERS AND REPORTS ARE FOR THE USE ONLY OF THE CLIENT TO WHOM THEY ARE ADDRESSED AND THEIR COMMUNICATION TO ANY OTHERS OR THE USE OF THE NAME TESTING SERVICES, INC. MUST RECEIVE OUR PRIOR WRITTEN APPROVAL. OUR REPORTS, LETTERS, NAME, SEALS, OR INSIGNIA ARE NOT UNDER ANY CIRCUMSTANCES TO BE USED IN ADVERTISING TO THE GENERAL PUBLIC.

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Dalton, GA 30722  
(706) 226-1400  
tsioffice@optilink.us**



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| Material Condition:      | EXCELLENT:               | XXX | GOOD: | POOR:          | REJECTED: |
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| Test Depth:              | 9" Compacted             |     |       |                |           |

**TEST DATA:**

| Straight Propulsion         | 1                              | 2                              | 3                              | 4                              | 5                              |
|-----------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| Circumference of Rear Wheel | 75.375"                        | 75.375"                        | 75.375"                        | 75.375"                        | 75.375"                        |
| Area                        | 50.9656 ft <sup>2</sup> *lbs*s | 50.7835 ft <sup>2</sup> *lbs*s | 46.8308 ft <sup>2</sup> *lbs*s | 51.9699 ft <sup>2</sup> *lbs*s | 51.6752 ft <sup>2</sup> *lbs*s |
| Time                        | 7.69 seconds                   | 7.68 seconds                   | 7.60 seconds                   | 7.74 seconds                   | 7.72 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        | 7.17 radians                   | 7.17 radians                   | 7.17 radians                   | 7.17 radians                   | 7.17 radians                   |
| Average Torque (energy)     | 6.63 ft lbs                    | 6.61 ft lbs                    | 6.16 ft lbs                    | 6.71 ft lbs                    | 6.69 ft lbs                    |
| Total Work (energy)         | 90.02 ft lbs                   | 94.81 ft lbs                   | 88.35 ft lbs                   | 96.27 ft lbs                   | 95.97 ft lbs                   |
| Work/ft (force)             | 13.26 lbs                      | 13.23 lbs                      | 12.33 lbs                      | 13.43 lbs                      | 13.39 lbs                      |
| Drop Hi/Low Work/ft (force) | 13.26 lbs                      | 13.23 lbs                      |                                |                                | 13.39 lbs                      |
| Average Work/ft (force)     | 13.29 lbs (159.48 lbf-in)      |                                |                                |                                |                                |

| 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                                     | 55.4523 ft <sup>2</sup> *lbs*s | 66.0964 ft <sup>2</sup> *lbs*s | 67.3566 ft <sup>2</sup> *lbs*s | 67.0414 ft <sup>2</sup> *lbs*s | 71.1943 ft <sup>2</sup> *lbs*s |
| Time                                     | 7.68 seconds                   | 7.71 seconds                   | 7.75 seconds                   | 7.74 seconds                   | 7.81 seconds                   |
| Angle Traveled (degrees)                 | 91.0°                          | 91.0°                          | 91.0°                          | 91.0°                          | 91.0°                          |
| Angle Traveled (radians)                 | 1.59 rad                       | 1.59 rad                       | 1.59 rad                       | 1.59 rad                       | 1.59 rad                       |
| Arc Length Traveled by Outer Wheel       | 56.78 inches                   | 56.78 inches                   | 56.78 inches                   | 56.78 inches                   | 56.78 inches                   |
| Arc Length Traveled by Outer Wheel       | 4.73 ft                        | 4.73 ft                        | 4.73 ft                        | 4.73 ft                        | 4.73 ft                        |
| Angular Displacement of Outer Wheel      | 4.73 radians                   | 4.73 radians                   | 4.73 radians                   | 4.73 radians                   | 4.73 radians                   |
| Average Torque (energy)                  | 7.22 ft lbs                    | 8.57 ft lbs                    | 8.69 ft lbs                    | 8.66 ft lbs                    | 9.12 ft lbs                    |
| Total Work (energy)                      | 34.17 ft lbs                   | 40.58 ft lbs                   | 41.14 ft lbs                   | 41.00 ft lbs                   | 43.15 ft lbs                   |
| Work/ft (force)                          | 7.22 lbs                       | 8.58 lbs                       | 8.69 lbs                       | 8.66 lbs                       | 9.12 lbs                       |
| Drop Hi/Low Work/ft (force)              |                                | 8.58 lbs                       | 8.69 lbs                       | 8.66 lbs                       |                                |
| Average Work/ft (force)                  | 8.64 lbs (103.68 lbf-in)       |                                |                                |                                |                                |

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