Dynamic Response of Wheelchair Cushions to the ISO Impact Damping Test

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Abstract
Selecting an appropriate wheelchair cushion is not a trivial process. A wheelchair cushion must be able to optimize the load distribution as well as to minimize peak pressure which is crucial to pressure ulcer prevention. In addition, a wheelchair cushion has to provide adequate supportive properties to the user. The International Organization for Standardization (ISO) has been developing wheelchair cushion standards and tests to characterize physical and mechanical properties of such cushions. One of these tests, the impact damping test (IDT), characterizes the abilities of a wheelchair cushion to reduce impact loading on tissues and to help maintain postural stability. The objectives of this project are to evaluate the methodology described in the ISO standard, determine the repeatability of the accelerations resulting from the ISO test method and assess the test method’s ability to distinguish the impact damping performance of different cushions. A small cohort of 5 cushions was selected to represent variability in material and design of wheelchair cushions.

Aims
1. Evaluate a cohort of 5 wheelchair cushions using the IDT
2. Assess the feasibility and pertinence of ISO IDT for characterizing the impact damping characteristics of the wheelchair cushions

Test Rig

Experimental Protocol
1. Test procedures performed after ISO 16840-2, chapter 11.2
2. 3 operators tested all cushions on 3 different days
3. Each cushion was tested 6 times per day for a total of 18 tests per cushion

Wheelchair Cushions

<table>
<thead>
<tr>
<th>Cushion</th>
<th>Manufacturer</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot; flat HR 45 Foam #1</td>
<td>Hibco Plastics, Inc; Yadkinville, NC</td>
<td>Urethane foam with 45 IFD</td>
</tr>
<tr>
<td>3&quot; flat HR 45 Foam #2</td>
<td>Hibco Plastics, Inc; Yadkinville, NC</td>
<td>Urethane foam with 45 IFD</td>
</tr>
<tr>
<td>Cloud</td>
<td>Otto Bock USA,</td>
<td>Viscous fluid bladders within elastic foam base</td>
</tr>
<tr>
<td></td>
<td>Minneapolis, MN</td>
<td></td>
</tr>
<tr>
<td>Dream</td>
<td>Allegro Medical, Meza, AZ</td>
<td>Viscoselastic foam</td>
</tr>
<tr>
<td>Roho HP</td>
<td>The Roho Group,</td>
<td>Single valve adjustable air cushion</td>
</tr>
<tr>
<td></td>
<td>Belleville, IL</td>
<td></td>
</tr>
</tbody>
</table>

Note: - 2 samples of the same flat foam were used
HR=high resiliency; IFD=indentation force deflection; HP=high profile

Methods

Results and Discussions

Expected contact area during the rebound
a) at the rebound
b) a midpoint between the rebound and the impact
c) at the impact

Curve fit using under damped simple harmonic solution

ISO Criteria

Suggested Criteria

- results of both ratios were repeatable, but indicated differences between rebound & impact ratios
- differences indicate that cushion responses are not reflected by a simple harmonic response
- impact acceleration occurs during greatest contact between indentor & cushion, insuring most linearity & consistent response

Acknowledgements

This work was completed as part of the Mobility RERC, which is funded by the National Institute on Disability and Rehabilitation Research of the U.S. Department of Education under grant number H133E030035. The opinions contained in this poster are those of the grantee and do not necessarily reflect those of the U.S. Department of Education. The author thanks Dr. Stephen Sprigle and Jayme Caspall for providing valuable insights and assistance.

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