Support Surface Standard Horizontal Stiffness Test

Caroline Portoghese, OTR/L, LNHA, ATP/SMS, MSCS; David Brienza, PhD

Horizontal Stiffness Small Working Group Members, Support Surface Standards Initiative, National Pressure Injury Advisory Panel

### Purpose
Detailed information provided by standardized testing will help clinicians objectively match the characteristics of a support surface to the needs of a patient population, and for individual users. The horizontal stiffness test provides helpful information for choosing a support surface when tissue deformation is a concern. Injury directly from tissue distortion may start to occur in minutes on a microscopic scale.

### Background
An important factor to be considered when selecting support surfaces is shear. One of the primary causes of shear stress is the force of the surface material pushing back on the soft tissue when a patient’s body position has been shifted laterally across the surface. Any body movement parallel to the support surface causes the surface materials to deform and push back on the body in response to this movement. Movement across the surface is not needed for tissue deformation to occur. A very stiff surface exerts a high resisting force on the tissue in response to a given amount of displacement. If the surface is less stiff, the force opposing this specified displacement will be lower.

### Methods
Section 5 of the ANSI/RESNA SS-1 was developed as a test method for determining the horizontal stiffness or the “shear modulus” of a support surface.

<table>
<thead>
<tr>
<th>Shear Force, Stress, Strain</th>
<th>Measuring Horizontal Stiffness</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shear Force</strong> – force acting parallel to the interface units: Newtons or lbs-force</td>
<td>The method’s objective is to measure the net pushback force on the pelvic indenter associated with a small horizontal displacement toward the foot of the surface.</td>
</tr>
<tr>
<td><strong>Shear Stress</strong> – shear force divided by the area of the element’s surface to which the shear force is applied, ( \frac{\text{units: force per unit area}}{\text{KPa}} )</td>
<td><strong>Shear Strain</strong> – relative deformation parallel to cross section, ( \frac{\Delta}{T} )</td>
</tr>
</tbody>
</table>

Elevating the head of a bed enables gravity to pull the user down on the support surface, while the support surface itself pushes back (friction) to hold the patient in place, causing the user’s tissues to experience Shear forces.

### Results
The standard test method on Measuring Horizontal Stiffness in Support Surfaces is intended only to help differentiate the horizontal stiffness or shear modulus characteristics between support surfaces and is not intended for determining overall performance. The measurement is not a local shear stress metric, it is the total force resisting a load’s translation across the surface. The actual force on any specific area is higher or lower.

### Conclusion
The results from the Horizontal Stiffness test can be a helpful resource when selecting a support surface for a user or population that is known to be in a high-risk position for tissue deformation, such as when the head of the bed is elevated for medical reasons.

### Clinical Implications
A higher horizontal stiffness may offer more stability but also an increased chance of tissue deformation due to shear forces between support surface and patient.

### References