Guidance on Interpretation of Performance Standards for Support Surfaces

The table below provides guidance on how to interpret performance measures obtained from ANSI/RESNA SS-1 Requirements and Test Methods for Full Body Support Surfaces.

Support surface performance standards have been developed to facilitate comparisons between products relative to clinically important external factors of pressure injury prevention and treatment. Tests can be performed by manufacturer or independent test lab, as long as standards are followed. Tests are performed with support surface at 0° head of bed elevation and at one test load. The adjustable mattress support platform may impact support surface performance.

These methods are intended to help differentiate individual performance characteristics between full body support surfaces. They have been shown to differentiate performance levels of a range of available products and therefore should be a consideration for pressure injury prevention and treatment.

As currently understood, no individual test result is predictive of pressure injury prevention effectiveness. The different standard tests and their results can be used in the selection process of a support surface in a care setting. Standard tests are not intended to demonstrate clinical outcomes or determining overall ranking or scoring of support surfaces, rather they should be used to match user needs to specific device capabilities and performance.

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### Pressure Injury Prevention:
An exercise in balancing:
Assessment of the patient risk factors and matching the performance of support surface to mitigate patient individual risk factors.

Matching Support Surface characteristics with individual patient needs or targeted patient populations.

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<tr>
<th>Support Surface Characteristics</th>
<th>Individual Patient/Target Population Needs</th>
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<td><strong>Pressure Redistribution</strong></td>
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<td>• Hemispherical Indenter Immersion and Envelopment Test (SS-1:2019, Section 6)</td>
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<td>• Dual Semispherical Indenter Envelopment Test (SS-1:2019, Section 7)</td>
<td>• Microclimate Management</td>
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<td>• Full Body Immersion Test (SS-1:2019, Section 2)</td>
<td>• Temperature</td>
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<td><strong>Moisture Management</strong></td>
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<td>• Body Analog Method (SS-1:2019, Section 3)</td>
<td>• Moisture</td>
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<td>• Sweated Guarded Hot Plate (SGHP) (SS-1:2019, Section 4)</td>
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<td>• Heated Water Bladder Method (HWBM) (SS-1:2019, Section 8)</td>
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<tr>
<td><strong>Shear Management</strong></td>
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<tr>
<td>• Horizontal Stiffness Test (SS-1:2019, Section 5)</td>
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**Pressure**: will contribute to some collapse of arteries and veins due to distortion and deformation of soft tissue thereby limiting the supply of nutrients and oxygen, while also limiting elimination of cells byproducts. Another consequence of pressure is when tissue is compressed against a boney prominence it will create vertical shear force creating even more tissue distortion.

**Shear**: will contribute to some collapse of arteries and veins due to distortion of skin tissue thereby limiting the supply of nutrients and oxygen, while also limiting elimination of cells byproducts. Another consequence of shear is when skin exhibits poor mechanical properties it might disrupt the skin layers, resulting in damage and possible ulceration.

**Elevated Relative Humidity (RH) and Temperature**:  
• Moisture
• Sweat is the best process to eliminate body heat. As RH increases at the skin interface, it limits a persons’ ability to sweat to regulate body and skin temperature, thereby increasing skin temperature and a cells metabolic rate.

With increased metabolic rate, the cell has increased demand for nutrients and oxygen as well as elimination of cellular byproducts
• Increased humidity within the skin also compromises collagen bonds between cells, reducing the skins mechanical properties (stretch, recoil) and resistance to tearing.
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<th>Interpretation of Results</th>
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<tr>
<td><strong>Immersion</strong></td>
<td><strong>Intent of method:</strong> This test provides one measure of pressure redistribution through immersion into the support surface. Increased contact area (evaluated by immersion and envelopment) disperses the individual’s weight and redistributes the pressure over a broader area.</td>
<td><strong>Validated Output</strong> Calculated Immersion (depth) (mm)</td>
<td>Products that are less stiff/firm will typically have higher immersion. Conversely, products that are more stiff/firm will typically have lower immersion values. This value is limited to the thickness of the support surface.</td>
<td><strong>Significance of high and low measurements:</strong> Higher levels of immersion provide opportunities for increased pressure redistribution. <strong>With excessive immersion:</strong> - Patients may feel like they are in a hole. - Bottoming out may occur. - Clinicians may find it difficult to reposition patient. <strong>With limited immersion:</strong> - Patients may feel the surface is hard and uncomfortable. - Less potential for pressure redistribution.</td>
</tr>
<tr>
<td><strong>Envelopment and Immersion:</strong> Hemispherical Indenter Test</td>
<td><strong>Intent of Method:</strong> This method provides measures of how well a surface immerses and conforms to the shape of the indenter that represents the pelvic region.</td>
<td><strong>Validated Outputs:</strong> (1) Immersion depth (mm) (2) % Envelopment (contact depth / immersion depth) (3) Peak Pressure (mm Hg) (4) Peak Pressure / Immersion (mm Hg/mm depth)</td>
<td>Softer surfaces show greater immersion and envelopment than stiffer surfaces. Air fluidized therapy surfaces may envelop full depth. Powered air products can be used to set different levels of stiffness by adjusting the internal pressure in the surface. High levels of immersion with high levels of envelopment is consistent with a high degree of pressure redistribution.</td>
<td><strong>Significance of high and low measurements:</strong> Immersion and envelopment must be considered together. <strong>Immersion (mm)</strong> – Lower numbers indicate a firmer support surface with less potential for pressure redistribution. Higher numbers may cause the patient to feel like they are laying in a hole and make it difficult to reposition. <strong>% Envelopment (Contact depth/immersed depth)</strong> – High envelopment is beneficial to pressure redistribution. <strong>Peak Pressure (mmHg)</strong> – Consideration of the peak pressure can be used to confirm that high immersion and high envelopment are resulting in force redistribution. We expect that high immersion and high envelopment result in a low peak pressure. The opposite would also be expected to be true.</td>
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</table>
## Performance Test

### Test Overview

### Performance Measures

### Interpretation of Results

### Guidance

**Peak Pressure/Immersion (mmHg/mm)** – a higher number indicates high pressure with low immersion. A lower number indicates low pressure with high immersion. This is another indication of envelopment. High peak pressure with high immersion would indicate poor conformance of the surface.

**Peak Pressure/Mean Pressure**

A result close to 1 indicates a lower pressure gradient at the bottom of the indenter. As the result increases greater than 1 it indicates a higher pressure gradient at the bottom of the indenter.

### Envelopment: Dual Semispherical Indenter Test

**Intent of method:**
The indenter used in this test is highly contoured surface with 18 sensors on 4 depth levels designed to simulate a human pelvis.

This test is intended to differentiate surfaces that are high envelopment surfaces.

**Validated Outputs:**
1. Average Immersion depth (mm) of 10 trials
2. Average pressures of the last 10 seconds of testing for levels 1 and 4.

A very effective envelopment surface will show similar values at all elevations 1 through 4. A zero value at elevation 4 and a high value at elevation 1 indicate a poor enveloping surface.

**Significance of high and low measurements:**
Immersion and envelopment must be considered together. High levels of immersion make it possible for a surface to envelope a large surface, in the contrary case, low immersion prevents a significant amount of envelopment. The combination of immersion and envelopment are predictive pressure redistribution.
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<td><strong>Horizontal Stiffness Test</strong></td>
<td>The Horizontal Stiffness 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>
<td><strong>Validated Output:</strong> Results are reported in newtons (N) of force.</td>
<td>Support surfaces with fluid-filled elements generally exhibit lower force measurements on this test compared to support surfaces with elastic materials such as polyurethane foam.</td>
<td><strong>Significance of high and low measurements:</strong> The higher the sustained (after 5 minutes) force it takes to pull the indenter, the higher the horizontal stiffness of the support surface. Higher force measurements indicate the support surface has greater potential to apply a sustained force across the surface resulting in tissue deformation. Lower force measurements indicate small movements will result in lower sustained pushback force on the patient. Clinical conditions may dictate the most desirable response depending on the priority given to risk of shear forces and importance of maintaining position in the bed. Keep in mind that ease of translation indicated by low force measurements may be offset by undesirable user response as they resist the motion of migrating down the surface.</td>
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<tr>
<td><strong>Heat and Water Vapor Dissipation: Body Analog Method</strong></td>
<td>The Body Analog method specifies a method for the simultaneous measurement of the heat and water vapor dissipating properties of full body support surfaces under test conditions that simulate seat section loading with flat and contoured profiles.</td>
<td><strong>Validated Outputs:</strong> Provides temperature (°C) and Relative Humidity (%RH) at the skin/support surface interface. RH and temperature are measured at 60, 120 and 180 minutes then again after a brief lift off the surface.</td>
<td>Products that tend to provide more resistance to heat flow and less breathability will have higher temperature and R.H. On the other hand, products that tend to provide less resistance to heat flow and more breathability will have R.H. closer to 50% with lower temperature.</td>
<td><strong>Significance of high and low measurements:</strong> RH and temperature generally increase from the beginning of the test and stabilizes at a steady state value. RH measurements on the surfaces with the highest moisture removal hold RH near ambient test conditions (50% RH). Temperature measurements on surfaces with the highest heat removal hold surface temperature lower and surfaces with no heat removal capability allow the test temperature to increase to about 37 °C which is the temperature of the indenter.</td>
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**Heat and Water Vapor Dissipation: Body Analog Method**

**Intent of method:**
This method was designed to simulate the water vapor and heat production of a typical person and measure how these accumulate over time at the interface.
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| Heat and Moisture Dissipation: Sweating Guarded Hot Plate Method | The Sweating Guarded Hot Plate method is designed to simulate the transfer processes of heat and moisture through materials next to the human skin and to measure the rate of transfer of heat and moisture. This method is particularly relevant for assessing the ability of support surface materials to transmit moisture or heat, primarily under constant unvarying state ambient conditions. | Validated Outputs:  
(1) Dry Heat Flux,  
(2) Wet Heat Flux and  
(3) Evaporative Capacity (g/m²/hr.)  

**Application, Benefits and Limitations:** Provides data on dry and wet states including the ability of the support surface to dissipate heat and moisture at the skin/support surface interface. | Products that tend to provide more resistance to heat flow and less breathability (maintain their heat and moisture) will have numbers nearing 0 W/m² and 0 g/m²/hr.  

On the other hand, products that tend to provide less resistance to heat flow and more breathability (dissipate their heat and moisture) will have numbers with higher values of dry and wet heat flux as well as Evaporative Capacity. | **Significance of high and low measurements:**  
Dry and wet heat flux provide insights on the support surfaces rate of removal for heat. The higher the number, more heat can be pulled away from the body, the inverse is also valid, meaning the lower the number the less heat loss will occur from the patient.  
A second outcome of this test is evaporative capacity, which provides insight into the ability of a support surface to remove moisture away from the body, the higher the number the more moisture may be removed from the surface of the patient’s skin. |
| Water Vapor Dissipation: Heated Water Bladder Method | The Heated Water Bladder method measures the water vapor dissipating properties (moisture transport) of full body support surfaces. | Validated Output:  
Steady state of moisture vapor transmission rate (Evaporative Capacity) (g/m²/hr.)  

**Application, Benefits and Limitations:**  
The test is representative of a human torso. It is a measure of the mass of liquid and vapor transmission into the surface over a relatively large area.  

Test measures the support surface’s ability to remove moisture but does not measure heat removal. Moisture and heat removal can be impacted by the patient in the bed, number of layers of linen, temperature & humidity of the room. | Products that tend to provide more resistance to moisture vapor flow and thereby allow patient to maintain their moisture will have number nearing 10 - 15 g/m²/hr.  

On the other hand, products that tend to provide less resistance to moisture vapor flow and thereby allow patient to evacuate moisture better will have higher Evaporative Capacity. | **Significance of high and low measurements:**  
Dry and moisture removal can lead to desiccation.  
Low moisture removal can result in increased moisture at patient and support surface interface which may contribute to moisture associated skin damage (MASD). |