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## Cushion Design Principles

Wheelchair cushions are designed to address specific seating goals. Each design principle has specific clinical benefits and considerations. Therefore, understanding the design of a wheelchair cushion is critical in achieving the desired benefits to the wheelchair user. This reference table explains the various design principles that are used in wheelchair cushions and the clinical application that should be considered when choosing a cushion.


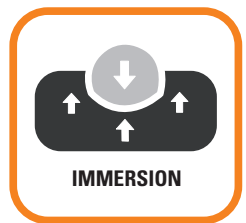



JAY Fusion® Cushion with available options displayed here.



# Cushion Design Principles (Continued)

Design Principles	Description	Clinical Application	Additional Considerations
 <p><b>POSITIONING CAPABILITY</b></p>	<p><b>Positioning capability</b> is the ability of a seating surface to create a shape. This is accomplished by using one or a combination of the following: modifying the cushion material, adding or subtracting components, or controlling the volume and location of fluid</p>	<p>Postural asymmetries which are reducible, frequently become non-reducible when not corrected by using a positioning technique.</p> <p>Non-reducible postural asymmetries need proper support to ensure a comfortable, safe sitting experience and pressure management.</p> <p>Without the ability to properly position, individuals who have postural asymmetries may be at risk of further health and functional problems.</p>	<p>Is the cushion able to provide adequate support to reduce or accommodate the individual's postural asymmetries?</p> <p>Can positioning components be added or subtracted?</p> <p>Does the cushion help maintain the pelvis in position?</p> <p>Can the volume of fluid (air or liquid), when used, be controlled bilaterally?</p>
 <p><b>PRE-CONTOURING</b></p>	<p><b>Pre-contouring</b> is the shaping of material to change the cushion's distribution of seated pressure and promote seated stability.</p>	<p>Pre-contouring can be done by different heights of foam or air cells.</p> <p>A pre-contoured design can provide a base for additional positioning components.</p> <p>Pre-contouring is often used in combination with other design techniques.</p>	<p>Does the pelvis fit into the pre-contoured design?</p> <p>Does the pre-contouring design provide loading onto appropriate body parts?</p>
 <p><b>FIRMNESS LAYERING</b></p>	<p><b>Firmness layering</b> is using multiple layers of materials with varying firmness to change a cushion's ability to distribute load.</p>	<p>A common form of firmness layering is to use a firmer material under the thighs and a softer material under the ischial tuberosities to redistribute the load to the thigh region.</p> <p>Materials that are too hard or too soft can affect stability.</p> <p>Firmness layering helps to reduce the chance of tissue breakdown under the ischial tuberosities.</p> <p>Firmness layering can also aid in positioning and overall stability.</p>	<p>Does the cushion material provide adequate stability or is it too soft?</p> <p>Would a firm layer of material as a base improve stability?</p> <p>Is the top layer of material soft enough to allow for comfort and immersion?</p> <p>How and why is the manufacturer using firmness layering in this cushion?</p>
 <p><b>SEGMENTATION</b></p>	<p><b>Segmentation</b> is the division of a material into segments to reduce tension within the material.</p>	<p>Segmentation allows materials to better conform to the shape of the pelvis, which effectively reduces peak pressures.</p> <p>Without segmentation, surface tension may prevent the pelvis from sinking fully into a material such as foam, gel, fluid or an air bladder.</p> <p>Air cell cushions have a segmented design which may require a cover to prevent cells from splaying.</p> <p>Segmentation may decrease the durability of the foam.</p> <p>Segmentation may be used to prevent fluid from migrating away from the desired location.</p>	<p>Has the foam performance been reduced by segmentation?</p> <p>Has the integrity of the cushion been impacted by the segmentation?</p> <p>Are the bony prominences located between segments causing pressure from firmer material?</p>

# Cushion Design Principles (Continued)

Design Principles	Description	Clinical Application	Additional Considerations
	<p><b>Stability</b> is a cushion's ability to provide both lateral and/or forward stability.</p>	<p>Poor postural stability can easily lead to postural asymmetries such as kyphosis, scoliosis, and lordosis.</p> <p>Stability enhances the individual's ability to maintain the pelvis position while propelling their wheelchair.</p> <p>Cushions with good lateral stability may support the trochanters and pelvis to help prevent a posterior pelvic tilt.</p> <p>When a cushion provides pelvic stability, it allows for more mobility in the extremities.</p> <p>Poor lateral and forward pelvic stability will increase the likelihood of the trunk displacing.</p>	<p>What is the individual's dynamic stability?</p> <p>Is the individual able to reach without becoming unstable?</p> <p>Is postural alignment maintained during activity?</p> <p>How firm is the material at the point of support?</p> <p>How firm is the material anterior to the ischial tuberosities?</p>
	<p><b>Immersion</b> is the ability for the body to sink into material. It is defined as the depth the body sinks into the support surface.</p>	<p>Foam compresses under load to allow the body to immerse. Surface tension in the foam and its coverings can limit that immersion.</p> <p>Softer cushions with low Indentation Force Deflection (IFD) will allow the pelvis to sink into the support surface.</p> <p>Fluid materials such as JAY® Flow Fluid may allow for more immersion than solid or semi-solid materials.</p> <p>Ideally, pressure is reduced at a site of a bony prominence as they increasingly immerse into a cushion.</p>	<p>Does the pelvis immerse deep enough into the cushion material?</p> <p>Is the material thick enough to allow immersion without hitting the bottom?</p> <p>Is the surface tension of the cover limiting the immersion?</p> <p>Is the immersion creating tension under the ischial tuberosities?</p>
	<p><b>Envelopment</b> is defined as the support surface's ability to conform around the contours of the body.</p>	<p>A cushion with greater envelopment properties allows for greater surface contact area to redistribute load, with reductions in peak and mean pressures under bony prominences.</p> <p>Envelopment occurs when the material in the cushion surrounds or engulfs the shape of the buttocks and body.</p> <p>Material selection is important when intending on enveloping bony prominences.</p> <p>Some materials, such as JAY Flow Fluid will fit or mold around the irregular shape of the body better than others.</p>	<p>Is the body shape irregular and requiring materials in which to be enveloped?</p> <p>Does the shape require specific contouring to accurately be enveloped?</p> <p>Could the buttocks be enveloped more with a different design or material?</p>

# Cushion Design Principles (Continued)

Design Principles	Description	Clinical Application	Additional Considerations
	<p><b>Off-loading</b> is the reduction of pressure from one area of the body to another in an effort to reduce risk of tissue injury.</p>	<p>Off-loading takes forces away from high risk areas and transfers them to low risk areas.</p> <p>Requires firmer materials on the load bearing surfaces. Off-loaded areas may seem suspended.</p> <p>The goal is to reduce the pressure under the ischial tuberosities and to redistribute pressure to the thighs or other parts of the seated body.</p> <p>Less direct pressure under bony prominences may lead to the reduction of pressure injuries.</p>	<p>Can the area of loading tolerate additional pressure?</p> <p>Has the load been moved to enough low risk areas?</p> <p>Is the individual comfortable on the firmer materials required for off-loading?</p>
	<p><b>Anti-shear</b> designs combine immersion, stability and low-friction surface materials to protect soft tissues from damage due to sliding forces.</p>	<p>Shear is defined as the forces generated when the pelvis moves within the soft tissues of the body. The goal is to have the surface, body and skin move together.</p> <p>The shape of the cushion can prevent the pelvis from sliding forward. This is especially important during propelling or when reclining.</p> <p>Using materials that allow the tissue to move along with the pelvis will prevent shear.</p> <p>Cushion cover materials which allow the pelvis to immerse into the materials will affect the potential for shear reduction.</p>	<p>Is the cushion maintaining the pelvis, especially with activity?</p> <p>Does the shape of the cushion cause the pelvis to move during reclining?</p> <p>Is the cover preventing the tissue from moving along with the pelvis or from getting the benefits of materials underneath, such as fluid?</p>

## References

1. Freedman, J. et.al, (2019). Reliability of a standard test for wheelchair cushion envelopment characteristics. RESNA Annual Conference. Pittsburgh.
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3. Watanabe, L. (2017, September). Immersion, envelopment and off-loading. Mobility Management. Retrieved from: <https://mobilitymgmt.com/Articles/2017/09/01/Seating-Strategies.aspx>

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