Foam cushions

Foam technology has come a long way. No longer just the soft, airy stuff of the past, foam now comes in a range of densities and with varying degrees of "memory," holding its shape as you sit, contributing to your stability. The new foams can adapt to any shape, and still provide even support, spreading pressure across the sitting surface. Different foams are often used in combination, layered for their various properties of softness, even support, and memory.

Foam is relatively inexpensive, and it is easy to cut. A therapist can experiment with shapes free of financial risk. If you have an area of skin that is broken down or on the verge, pressure can easily be reduced by cutting out a portion of the cushion. (You should not do this on your own, though, because only a doctor or therapist can identify the changes in your cushion that will help relieve pressure while still maintaining appropriate support.)

On the downside, foam wears out faster than other materials and loses its shape, but because of its lower price, this might not concern you. If you choose a foam cushion, be sure to replace it when its time is up. Old foam that is compressed can allow pressure points to form that can lead to a sore.

If you choose a gel or air flotation cushion for daily use, it is a good idea to have a backup foam cushion since gel and air flotation cushions can leak.

Gel cushions

Gel cushion designs attempt, in effect, to replace the consistency and support of atrophied muscle tissue. Highly engineered gel fluids are placed in pouches and usually attached to a foam base, so that the cushion conforms to the pressures placed on it. As a result, gel cushions provide excellent pressure distribution and are very comfortable. Many gel products also offer supplemental inserts to stabilize your legs. Your knees might tend to fall together (adduction) or apart (abduction), so such an accessory can help keep your legs straight which also aids your overall posture.

Unfortunately, gel cushions are much heavier than other types, which can cancel out some of the benefits of your lightweight wheelchair. Gel suppliers such as Jay and Flofit offer lighter, active-use designs, but these might not be appropriate for you if you are unable to do your own pressure-relief lifts.

If you bounce up and down curbs, or commonly experience similar impact in your chair, a gel cushion might not be ideal. When you sit in a gel cushion, there is no further "cushiness" to absorb impact, a concept known as impact loading. Other cushion types are better able to absorb impact.

Another drawback to gel cushions is the possibility of them "bottoming-out" as the gel is pushed aside by your weight. You can help prevent this distribution problem by kneading your gel cushion once a day, keeping the fluids loose and spread evenly. Look for a design that divides the gel portion into several sections so that all of the gel cannot push to the sides.
There is also the chance of the gel leaking. While cushions arrive with patching kits, patches are ineffective when the breach is at a seam, which is often the case. A leak might be very minor, or it could be an extremely messy affair.

**Air or dry floatation cushions**

Air floatation cushions support the body entirely on air. A typical example is the Roho cushion, designed with a group of small, interconnected rubber balloons arranged in rows. Pressure is balanced by air shifting out to surrounding balloons, spreading pressure evenly against your skin. The whole system is closed so air floatation cushions can't bottom out the way gel cushions can.

If you have a pressure sore, you can tie off individual balloons to reduce contact under that area, allowing you to spend more time sitting as the sore heals. The Roho Quadro allows the user to inflate four quadrants separately for optimal positioning. Air cushions are relatively lightweight, and are waterproof, allowing for double duty in the bathtub or on a boat.

Crown Therapeutics, maker of the Roho cushions, also offers air floatation products for the wheelchair back, supplemental lumbar or sacral support, full bed cushions, and even a product for a standard toilet seat. All are inflatable to adjust to your needs.

A longtime presence in disability magazines has been an ad for the "Bye-Bye Decubiti" cushion. It is inflatable, comes in many different sizes and shapes, is made of heavy duty rubber, and—although different from the Roho balloon design—is uniquely formed to minimize pressure at the bony protrusions on which we sit.

Air cushions can be less stable for those who move around a lot in their chair, but recent designs offer either low profile or quadrant options that minimize this problem. The balloons used in air cushions can be punctured, of course, and leaks do occur, although a fairly heavy duty rubber is used. But patching them is easier than with the gel design. The hard part is submerging the cushion under water to find the leak (look for escaping air bubbles).

The biggest drawback to air cushions is that they require more maintenance. It is necessary to check the pressure frequently, especially if you have pressure sores.

**Urethane honeycomb cushions**

Thermoplastic urethane honeycomb cushions are the most recent development in the world of cushions. Because there are many individual cells--like a beehive--these cushions are able to distribute weight evenly, but there is no risk of leaking gel or of an air bladder being punctured. The many open spaces in the beehive structure of the cushion allow air to travel more effectively. This design helps to protect against skin breakdown because your skin is kept cooler and moisture is prevented from collecting.

Urethane honeycomb cushions are very light, absorb shock, and a low profile cushion can provide significant support. These cushions can even be thrown into your washing machine and dryer, making them attractive for people with incontinence problems
where the cushion will be soiled from time to time despite best efforts at bowel and bladder management.

Supracor of San Jose, California, makes several honeycomb cushions based on their patent. One type uses multiple layers of varying stiffness to allow your sit bones to sink into the cushion while deeper layers provide overall support and weight distribution. Another type is contoured to provide adduction and abduction, plus a rear dish for pelvic positioning. There is not much of a track record for urethane honeycomb cushions because of their recent development, but there appears to be good prospects for this type of cushion to evolve and become more widely used.

**Comparison of Main Types of Cushions**

<table>
<thead>
<tr>
<th>Cushion type</th>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>Gel</td>
<td>Excellent pressure distribution. Very comfortable. May have supplemental inserts to stabilize legs.</td>
<td>Heavy. Chance of leakage. Less able to absorb impact. Some designs allow gel to push out to sides.</td>
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Wheelchair Cushion Differences

by Stephen Sprigle, Ph.D., PT

Understanding the materials used to make wheelchair cushions can help you choose your best seat and back.

Materials used for wheelchair cushions have come a long way. You now have quite a choice based on your individual need. Cushions protect skin from damage that can lead to pressure ulcers, and they affect many functional activities such as reaching, transfers and wheelchair propulsion.

Many researchers and clinicians who have studied cushions have developed a common conclusion: ‘No one cushion is best for all people’. Because so many cushions are available commercially, wheelchair users should be able to find one that adequately meets their needs.

How do you do that? First you need to understand the materials used to make cushions. Cushions are designed to distribute body weight over its surface or to re-distribute pressure away from areas considered ‘at risk’ for pressure ulcer formation. Many different materials and combination of materials are used in cushions, all of which have both positive and negative characteristics. In addition, several terms are used to describe cushions.

Becoming familiar with the words used to describe materials and construction will help you select the right product. These definitions are used by the Paralyzed Veterans of America and by the Rehabilitation Engineering and Assistive Technology Society of North America. A few of these terms are:

- **Foam or flexible matrix**: a lightweight, flexible cellular material used in support surfaces.
- **Viscoelastic foam or matrix**: a compressible cellular material that has both elastic (spring-like) and viscous (time-dependent) properties. Viscoelastic foam is different from regular foam by having time-dependent behaviors such as creep, stress relaxation, and hysteresis. This type of foam is sometimes called ‘memory foam’ because it maintains the shape of an indentor (like your hand) before springing back to its original shape. NASA invented the first visco-elastic foam, T-foam, about 40 years ago.
- **Non-deforming foam or matrix**: a support material that does not compress, deflect, or deform under sitting forces; often-used in cushion bases (Sunrise Medical Quickie Jay; Otto Bock Cloud [shown here] cushions use non-deforming foam bases).
- **Bonded foam**: adhesion of foam material including different foams being glued together (The Invacare Ultimate cushion is made with bonded foam)
- **Viscoelastic fluid**: a relatively incompressible substance with viscous properties; viscous fluids do not flow as readily as water and include maple syrup and grease. (Otto Bock Floam, Sunrise Medical Quickie JayFlo are viscoelastic fluids.)
- **Air cushion**: a cushion with an impermeable (air-tight) membrane containing air. (Crown Enhancer [shown here])
- **Water cushion**: a cushion with an impermeable membrane containing water.
- **Gel or solid elastomer**: solid rubber-like, relatively incompressible material.
- **Segmented cushion**: a cushion whose surface is divided into separate and distinct segments. (Span America’s PRT)
Convoluted cushion: cushion surface composed of convex protrusions separated by depressions or sulci; often called 'egg-crate'. (Span America)

Contoured: shaped to fit or reflect the form or shape of the body, specifically, the buttocks. (Invacare Ultimate)

Cut-out cushion: surface having a disruption or removal of material to alter the load bearing characteristics of the surface.

Certain characteristics can be used when judging the appropriateness of support surfaces. Recently, a panel of health care professionals, researchers and industry representatives identified nine characteristics that impact efficacy and should be considered when selecting support surfaces (Krouskop & van Rijswijk, 1995) (Table 1). The management of forces (pressure, friction), heat and moisture directly affect the health of skin.

Important Support Surfaces

<table>
<thead>
<tr>
<th>Characteristics</th>
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<tr>
<td>Redistribuition of Pressure -- A cushion should support your body weight without causing harm to your skin.</td>
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<tr>
<td>Skin Temperature Control -- You should not sweat when seated on a cushion. Some materials such as foam are naturally hotter than other materials such as gel.</td>
</tr>
<tr>
<td>Skin Moisture Control -- A cushion should help keep your skin dry and should not allow moisture or wetness to build-up next to the skin because wet skin is more easily damaged.</td>
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<tr>
<td>Patient/Product Friction -- The friction between the cushion cover and your clothes should not be too great (prevents you from transferring) or too little (allows you to keep sliding off the cushion).</td>
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<tr>
<td>Life Expectancy -- You should know how long a cushion is expected to last so it can be replaced before problems arise.</td>
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<tr>
<td>Flammability -- A cushion should not ignite into flames if a cigarette is dropped on it.</td>
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<tr>
<td>Fail Safety -- You should know what happens to your cushion if it breaks or becomes unusable.</td>
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<tr>
<td>Infection Control -- A cushion should not encourage or promote the formation of bacteria or other germs.</td>
</tr>
<tr>
<td>Product Service Requirements -- An owner’s manual should tell you how to clean and maintain your cushion and who to contact if a problem arises.</td>
</tr>
</tbody>
</table>

Knowing the durability of a cushion is important so you know how often it should be replaced. Typically, cushions should be replaced about every two to five years with all-foam cushions having a shorter life compared to other materials. Set-up and maintenance requirements should also be considered when selecting cushions. If you are unsure about how to use a cushion, chances are you will use it incorrectly.

Support surfaces can be thought of as having one or more of these three characteristics to distribute load (the weight of your body): compression, displacement and tension. Quite often, cushions are created using different materials and therefore, use a combination of these characteristics to distribute load.

Materials that compress include foam and air. Solid gel, water and viscous fluid displace when loaded (bear weight) as these are incompressible materials. Covering materials such as vinyl, cotton, and Lycra support the body in tension. Regardless of the materials used, the effectiveness of a support surface depends on its ability to distribute pressure without hindering function or increasing the potential for skin damage.

Foams are typically light and vary widely in stiffness and density. Stiffness refers to the firmness or hardness of a material, whereas density relates to a material’s weight.
per volume. Foams used in wheelchair cushions have medium stiffness in the range of 40 to 60 IFD (Indentation Force Deflection is a standard measure of foam stiffness with a higher number indicating a stiffer foam) while bed overlays can be softer (30 IFD) because loads are less when lying down since your weight is distributed over a larger area. Foams that are appropriate for a mattress will be too soft for use in sitting. Egg-crate mattresses and other foam mattresses should never be cut into pieces for use as wheelchair cushions. Foams used as support surfaces should have a higher density (thicker and more difficult to compress) than non-supportive foams and be classified as high resilience (HR) foams.

Proper stiffness, density and resilience help ensure adequate support and an effective lifespan. Foam envelops the buttocks well, but can be hot and is damaged by moisture and light, so a protective cover should be used. Covers made from fabric that does not stretch and is fitted tight around a cushion tend to negate the compressive benefits of foam.

Foam absorbs impact loads well, so it can help absorb the shock of going over bumps or obstacles.

Gels and viscous fluids are heavier than foams and, therefore, are often used in combination with foams. These materials are good at minimizing heat and are typically encased by a protective cover so are easily cleaned. Because of their incompressible nature, viscous fluid and gel cushions often use a contoured non-deforming foam base or a flat, compressible foam base to better enable the cushion to conform around the body. Gels and fluids absorb vibration but cannot absorb impact well. Therefore, these materials can absorb the vibrations that one might experience in a car, but not the impact one gets when bumping over a curbcut.

Air is highly compressible and would make an excellent support surface, except for its requirement of an impermeable membrane. Therefore, the efficacy of air cushions is directly related to the design of its container and proper inflation. Some encompass the body well while others do not. Some dissipate heat well, all can handle moisture without harm and most will absorb impact loads. Because air cushions are adjustable, they can be inflated to meet the needs of the user, but this adjustability also means that they must be maintained properly. An improperly inflated air cushion can be either too hard or too soft, and both are potentially damaging situations. If an air cushion is right for you, be sure to read the instructions so you inflate the cushion properly.

In summary, many characteristics must be considered before you select a cushion. These include cushion materials as well as other design characteristics. This article cannot tell you which material is best for you, but it can act as a source of information. All the cushion materials described in the article have positive and negative features. By better understanding these features, you’ll be better able to make choices about your wheelchair cushion. Anytime you decide to change wheelchair cushions, a clinician experienced in wheelchair seating should evaluate you and allow you to try out a few sample cushions, as well.
Seat Cushions are designed to offer:

- Comfort
- Pressure management
- Positioning
- Increased sitting stability

Indeed, there are many wheelchair cushions available - including foam, gel, and air technologies - and in understanding the benefits and limitations of each one, you can decide which is best for you.

**Cushion Varieties**
- Foam Cushions
- Gel Cushions
- Air Cushions

**Other Cushion Resources**
- Tips for Selecting & Maintaining a Cushion

**Foam Cushions**

Foam cushions are the most basic cushion, ideal for those wishing simplicity at minimal cost. While some foam cushions are a single-density (firmness), others feature contoured bases with multiple layers of foam, designed for enhance pressure management and positioning.

![Jay Basic Wheelchair Cushion](image)

**A foam cushion may be best for you if you need:**

- Low maintenance
- Minimal cost
- A very stable seating surface
- Low to mid-range positioning
- Light weight

**A foam cushion may not be best for you if you need:**

- Exceptional pressure relief
- Advanced positioning characteristics
**Gel Cushions**

Gel cushions are specifically designed to optimize pressure relief by allowing one's pressure points to "immerse" into a gel pack, reducing pressure. Additionally, gel cushions typically feature a contoured base, with advanced positioning characteristics.

![Trulife Relax PleezrElite Wheelchair Cushion](image)

*Trulife Relax PleezrElite Wheelchair Cushion*

**A gel cushion may be best for you if you need:**
- Optimal pressure relief
- Advanced positioning
- A very stable seating surface
- Low maintenance

**A gel cushion may not be best for you if you need:**
- Light weight
- Low cost

**Air Cushions**

As the name suggests, air cushions are filled with air, and by adjusting the air pressure, the cushion's firmness can be adjusted. Air cushions typically offer reduced stability and positioning by comparison to foam and gel cushions, but are exceptional in the area of pressure relief, allowing pressure points to “sink” into the cushion. Air cushions are commonly available in 2" and 4" heights, with the 2" offering a low-profile, more stable surface, and the 4" offering maximum pressure relief.

![ROHO LTV Seat Cushion](image)

*ROHO LTV Seat Cushion*

**An air cushion may be best for you if you need:**
- Exceptional pressure relief
- Adjustable firmness
- Light weight
- Low maintenance
An air cushion may not be best for you if you need:
- Low maintenance (air cushions require regular monitoring of air pressure, and can develop leaks)
- Advanced positioning characteristics
- Utmost seating surface stability
- Low cost

Selecting & Maintaining a Cushion
- A seat cushion’s size should be matched exactly to the wheelchair’s seat size
- Remember that a seat cushion’s height adds to the wheelchair’s seat-to-floor height, so a taller cushion will cause you to sit taller, accordingly (which can be an issue fitting under tables and desks)
- If there’s a chance that the cushion will be exposed to fluids, an incontinence cover should be used (incontinence covers come included with many cushions)
- Inspect the cushion regularly for degraded materials or damaged foam
- With air cushions, confirm proper inflation daily
- Most cushions have an optimal use life span of two to three years, so for proper performance, replace a cushion when needed