

## Where foam fits in medical design

A variety of different chemistries and manufacturing processes can fine-tune characteristics in foam, making it a good fit for a host of medical applications.

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Foam offers designers a full palette of potential materials. They can use it to absorb, seal, filter, wick, cushion, insulate or support loads. And to solve even more application problems, you can heat it, compress it, and laminate it to change its characteristics. Foam can play a crucial role in surgery masks, cervical collars, thermal insulation and wound-care products, as well as fluid regulators, laser surgery and other filters, oral swabs, protective packaging, and acoustic absorbers and dampers. This kind of versatility makes foam unique as a design material. And thanks to innovative fabrication techniques and the latest in polymer chemistry, foam can take on a wide range of different properties, including shape retention, water resistance or absorbency, porosity, density and a myriad of physical characteristics.

### It filters

The permeable cell structure of reticulated, open-cell urethane makes it well-suited for filtering, primarily because the open-pore structure leaves plenty of room to capture and hold

airborne or liquid contaminants. The high volume of void space lets the foam filter with relatively little air resistance or pressure drop. Despite porosities ranging from 3 to over 100 pores per linear inch, urethane foams have high tensile strength and tear resistance. As a result, they can be cut or molded into complex shapes without damage. Polyurethane ether's hydrolytic stability prevents swelling or degradation, which enhances liquid filtration. On the other hand, polyurethane ester is more useful to air filtration because of its good resistance to UV degradation and stronger tensile and tear properties.

Multi-layer filters can capture a range of different sized particulates. They can be made either by combining foams of different porosities, or foam in combination with other media, such as non-woven materials. Multiple layers also let biomedical engineers design systems that filter specific sizes of particulate that must be reclaimed.

Foams give engineers a range of customizable materials for designing medical equipment.



Applicator pads use several layers of foam to dispense liquids without dripping.

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### It wicks and dispenses

In some medical applications, open-cell reticulated foams act as reservoirs. They both wick and dispense liquid without letting it puddle on the applicator or drip. Cleanroom wipes, swabs for gels and liquids, and other fluid applicators made with foam, wick and dispense at controlled rates. You can control foam's wicking and dispensing rates by varying how much it is compressed or felted. Compressed foam retains its high void volume, so it can hold a relatively large amount of liquid and still retain its shape. Even a foam compressed to 1/10th its final original thickness still have a void volume of 70% (compared to uncompressed foam, which has a 97% void volume). Foam holds liquids on the surface and within its skeletal structure. Engineers can fine-tune the density, compression and capillary action, to match the viscosity of the liquid and how fast it must flow through the foam.

A pad made out of a series of foam screens, or layers with different porosities, will disperse liquids throughout its surface rather than stream through the middle. Urethane foams are also among the softest and lightest of all foams and therefore the most "patient-friendly."

### It cushions and supports

Whether used as cushioning on a face mask or on a neck collar, foam conforms to body contours. It also covers the spectrum from lightweight and low density to firm and supportive, depending on the required function. A variety of foam fabrication processes, such as cutting, laminating and felting, make open or closed cell foams

applicable to just about any cushioning or support requirement. Generally, the medical situation determines how long the device will be used and, therefore, what type of foam should be used. Short-term devices, those used only for recovery and then discarded, are usually made from both open or closed cell materials. Combining either with coverings can improve the user comfort. You can also attach hook and loop closures to foam for maximum adjustability.

### It insulates

Foams that insulate, whether acoustically, thermally or both, can be used in a variety of medical devices. They act as barriers to protect heat sensitive components or help retain heat inside a machine. Foam reduces noise from fans, pumps, compressors and other machinery. Generally, insulating foam is made from melamine. Compared to polyurethane or polyethylene, melamine is fiber-free, and its base chemistry lets it withstand much higher temperatures. For example, pinta foamtec's melamine foam, willtec<sup>®</sup>, is rated to withstand constant temperatures to 300°F, and short-term temperatures up to 482°F. It is an open cell, low density foam (0.7 lb/ft<sup>3</sup>) that dampens sound over a wide range of frequencies. It can withstand moisture and prevents microbial growth (UL 181) and fungus (ASTM G21), and resists organic solvents and a variety of diluted acids and alkali, including isopropanol, glycerin, sulfuric acid, citric acid, ammonia, water and caustic soda.



Specially cut polyurethane foam used in this oral swab is not so abrasive that it will harm patients' mouths and gums.



Combining polyethylene and hydrophilic form to make an absorbent covering keeps wounds warm and protected.