We Develop Latex-free Elastic Nonwovens & Create Soft-Stretch Protective Hoods

The lack of proper PPE for primary head protection has been a problem in all industries. Workers constantly expose their heads and faces to harmful substances in their daily jobs or to sunlight over extended periods of time. Fundamentally, the problem was that no suitable material was available for making head coverings that conformed to the contours of the wearer's head and face. Because the materials were stiff, the head coverings had to be made baggy to cover different head sizes. That created too much gapping to provide an effective barrier. Those head coverings did not fit well even when incorporated with elastic components. Further, there was a safety concern due to restricted peripheral vision impairing head movement and wearer's mobility. Consequently, they were not popular.

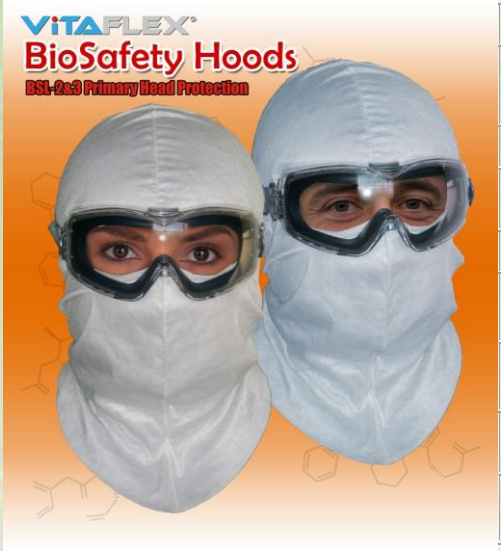
Spunmelt nonwoven fabrics are a "breathable barrier" and commonly used for making face masks and surgical gowns. VitaFlex's Elastic Nonwoven Technology transforms a wide range of spunmelt nonwovens into soft and cross-stretch elastic fabrics, without adding latex or other elastomers. This enables finished products to be form-fitting while maintaining their cool, breathable barrier quality. By combining elastic composites into multi-layer structures, we have created a series of soft-stretch hoods from elastic nonwoven composites. **Although there is no regulation or requirement for head coverings certification from any agencies, the FDA guiding principles for surgical masks were followed throughout the development process.**

The Latex-free Elastic Nonwoven Technology and the materials have been globally co-patented by DuPont© and Dr. De-Sheng Tsai. The precursor nonwovens are sourced from the most advanced lines in the southeastern states. The conversion and manufacturing processes are done in Burlington, North Carolina.

VitaFlex's Biosafety Hoods

Primary Head Protection for Biohazard Control & Infection Prevention

The innovative advantage is COMFORT- Soft Form-fit and Easy Breathability. (1) Soft firm-fit to securely cover the entire head, face, and neck. (2) Easy breathability to keep the head cool for extended wear.



	Biosafety Hood
Triple Layer Structure	SMS/SS/SMS
Basis Weight	70 gsm
Thickness	0.40 mm
ΔP (mm H_2O/cm^2) MIL-M-36954C	< 3.5
Breathability/Perception	Normal/Cool
Synthetic Blood Penetration Resistance ASTM F1862	Pass at 80 mmHg
Particle Filtration Efficiency @ 1 µm ASTM F2299	>90
Bacteria Filtration Efficiency ASTM F2101-14	>90
Particle Shed Analysis Helmke Drum Particle Counts	1,850 of ≥0.3 µm

- **Protect scientists and technicians in a variety of bio-labs or when working with microorganisms or around bio-hazardous waste or sewage**
- **Provide safety and health protection for morticians when caring for corpses: embalming, processing for cremation, and after task cleanup**
- **Prevent healthcare workers from contact transmission in many daily jobs such as treating or caring for patients, performing surgery procedures, reprocessing devices, cleaning contaminated rooms and furniture, bundling dirty bedding, and handling biomedical waste.**

Latex-free Elastic Nonwovens

Revolutionary Materials to Make Soft-stretch Hoods

Primary Head Protection was the critical component missing in conventional PPE because there was no material available for making protective hoods that are form-fit to the wearer's head and comfortable for extended wear.

Latex-free Elastic Nonwoven Fabrics are the breakthrough materials that give an elastic structure while maintaining the breathability and barrier functionality of nonwovens. **The elasticity** enables the making of protective hoods that are form-fitting on the wearer's head and becoming an isolation layer next to the skin. We have created **soft-stretch hoods** made from our newly developed elastic nonwoven fabrics to meet the safety requirements of many industries.

Keeping Heads Cool was a major criterion when we developed the Biosafety Hoods to be worn for extended periods of time. Throughout the development process, the FDA guiding principles for surgical masks were followed. An indicator of breathability is to measure the differential pressure (ΔP, mm H_2O/cm^2) across the web structure according to test method MIL-M-36954C. **FDA guidance** on surgical masks states that the wearer will feel hot when wearing a mask having a ΔP of more than 5. **The ΔP of the Biosafety hoods' structures is engineered to be less than 3.** Due to the low ΔP allowing perspiration vapor to escape, there is no unbearable heat or humidity build up inside the hood. The wearer should feel cool and comfortable in extended wear.

The Filtration Efficiency of Biosafety Hoods were engineered to filter particulates of 1 µm and larger at a flow rate of 1 cubic foot per minute (CFM) or 28.3 liters per minute (LPM). The efficiency of filtering submicron particulates is even higher (95-99% for 0.1 micron) because submicron particulates are mostly attracted by static and attach more tightly to the surface of fibers. The design of our full-cover hood forms an air-pocket around the nose and mouth to serve a facemask. This **p**rovides ample space and breathable surface which allows for dissipation of exhaled air. If worn properly with goggles that fit the wearer's face (seals around the nose and presses firmly on the nose bridge), our hoods can provide effective respiratory protection. Airborne particles (without highly pressurized force) cannot penetrate the structures of our Biosafety hoods that fit tightly against the wearer's hair and skin**.**

Blood Splash Resistance of Biosafety Hoods are qualified as level 1 liquid barrier (ASTM F1862) engineered to block body fluids or blood splashes at a velocity corresponding to human blood pressure of 80 mm Hg at a distance of one foot, which is for protecting healthcare workers in conducting surgical operations such as intubation.

Provide Respiratory Protection as Facemasks

The structures of our hoods have high filtration efficiency. When worn properly, they provide excellent respiratory protection. Since they do not have an adjustment mechanism, it needs to be worn under safety goggles to properly seal around the wearer's nose. Caution: VitaFlex's Biosafety hoods are NOT for replacing respirators required by OSHA.

The donning sequence is to put on our hood first, followed by goggles to protect the eyes. This completes full coverage of the head, face and neck (as shown in the photo to the right).

If higher filtration is required or against toxic fumes, our soft-stretch hoods can be worn under or over a mask or respirator. The structures of the hoods are very thin, only 0.3 - 0.4 mm. Many users have confirmed our internal tests that it provides an additional layer of barrier, a soft cushion of comfort, and reduces respirator movement from work or sweat.

Please note: Fit test your respirator as always with our hood to confirm its seal. If the full-cover hood interferes with the fit, use the open-face style that allows the respirator direct contact with the skin.

VitaFlex LLC 1305 Graham Street, PO Box 689, Burlington NC 27216
(888) 616-8848 Sales@vitaflexUSA.com

Wear Soft-stretch Biosafety hoods in conjunction with conventional PPE to solve many of their shortcomings

1. The Disposable N-95 Masks are commonly used by healthcare workers for respiratory protection. However, N-95 masks do not fit well on many people due to varied face shapes. Their latex straps are either too loose or too tight for proper fit. Also, fit testing cannot always guarantee against leakage since the mask can move while working. In reality, a protective hood is also needed to block the airborne droplets expelled at high velocity from a patient's coughing and sneezing that spray on the face and neck or fall on the hair. Those contaminants pose an equal or greater infection risk from subsequent contact transmission.

The Solution: Biosafety hood can be comfortably worn with a mask or respirator to keep the entire head, face and neck protected. Many workers have confirmed with our internal tests that wearing our soft-stretch hood under a mask (photo on the left) provides an additional layer of barrier and reduces gapping.

Fit testing your respirator as always with our soft-stretch hood to confirm its seal. If the hood interferes with the fit, try wearing it over the mask (photo on the right).

2. The Hooded Coveralls have been criticized for severely restricting the wearer's head movement and mobility. While working, the coverall hood easily pulls away from the wearer's face. Usually, duct tape has to be used to attach it to the face shield of a respirator. This actually worsens the problem of restricting head movement. The updated CDC guidance recommends the use of coveralls without integrated hoods.

The Solution: It is practical and economical to wear our Biosafety hood with an un-hooded coverall suit. Wearing two hoods is recommended. That way, the outer layer can be removed upon being contaminated while the inner layer remains in place keeping the wearer protected until there is no longer a danger and the respirator has been removed.

3. Powered Air Purification Respirator (PAPR) provides complete coverage for the head. However, of great concern is that the removal of the PAPR hood would immediately expose the wearer's head to contaminants accumulated on the suit. Even changing the doffing procedure to remove the PAPR last leaves a risk of accidental self-contamination from the contaminated PAPR.

The Solution: Wearing a Biosafety hood under the PAPR or hazmat hood provides continuous protection after removal of the contaminated suit. Our Biosafety hoods should be the first PPE put on and the last removed.

Caution: VitaFlex's soft-stretch hoods are NOT for replacing respirators in OSHA requirements. Not for blocking concentrate detergents, high viscosity solutions, organic solvent, toxic or bio-hazard gases, fumes, or vapors. Not for blocking pressurized liquid and particles.

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Conventional Materials for Making Disposable Protective Hoods

The Common Problem of the conventional materials is their stiffness. Due to the lack of dimensional stretchability, the hoods have to be made baggy.

Personal Protective Equipment (PPE) is worn to minimize exposure to harmful substances and reduce workplace illnesses. **Disposable protective hoods are commonly made of plastic film laminates, Tyvek sheets or nonwoven fabrics for their barrier functionality and low cost.**

1. **Plastic Films** are the best material in shielding against corrosive chemicals and organic solvents with their chemical inertness and absolute imperviousness to liquids. The film laminates on textile are to obtain high strength against tearing and puncturing. They are used for making hazmat suits. Laminates with nonwoven backing, having low strength against tearing and puncturing, are used for disposable protective apparel.

The hoods made of film laminates are impervious to air, so they have to be equipped with an air-fed system. They are bulky, inconvenient to wear, and expensive for many daily jobs.

2. **Tyvek Sheets,** like plastic film laminates, are impervious to liquids and chemically inert. They are used to make light-duty hazmat suits because their protection against puncture or abrasion is limited. Tyvek sheets are occasionally called “breathable material” by having a moisture vapor transmission rate (MVTR) of 5-10 liters/m²/24 hours tested at 100F°. However, the term “Breathable” used to describe their structure can be misleading. Such low volume of transmittable air is not adequate for human breathing since the average human respiratory rate requires at least 5 liters/minute. The design of exposing the face is most likely to avoid suffocation accidents.

Tyvek hoods are stiff and do not fit well. And worst of all, they are unbearably hot even when just worn for short periods of time. Without being equipped with an air-fed system, the hood can cause uncomfortable anxiety and dizziness from the buildup of body heat and humidity.

3. **Nonwoven Fabrics** are the best material for achieving a balance between “breathability” and “barrier functionality”. Spunmelt nonwovens made of polypropylene (PP) fibers are popularly used for making face masks, and coverall suits.

However, the high basis weight nonwoven fabrics that have the required filtration efficiency are too stiff to make the hoods fit well even when incorporated with elastic components. They fail to provide the intended layer of isolation because of serious gapping.

In 2014, the incident of healthcare workers in Texas contracting the Ebola virus disease while caring for an infected patient was an example of the terrible failure of conventional nonwoven head coverings. In recent Covid-19, many of healthcare workers got infected by leaving their head and face exposed even though a N95 or surgical mask was worn. When a mask is required, a head covering is needed as well.

It is commonly understood that infectious or other harmful substances falling on the head, face, and neck creates a fatal situation for people in any disaster. While stocking N95 masks, acquiring at least an equal number of protective head coverings is also necessary.

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