3M Science. Applied to Life.™

Technical Data Bulletin

"The Science of Protection"
Unraveling the science of coverall fabrics

3M recognizes that different jobs require different levels of protection. This is why the range of 3M™ Protective Apparel is diverse, and designed to provide options for your application and purpose.

If the only consideration for designing and selecting protective apparel was protection coveralls would be made with the most protective fabric possible –heavy and non-breathable. However, different applications require other considerations, such as the heat stress, physical demands of the work task and the type of environment in which it is used. These considerations add to the need for different designs and different fabrics. The 3M range of protective coveralls is designed and manufactured to offer options that help address these needs.

Let's begin by looking at the different types of fabric.

Many Type 5/6 coveralls which are designed to help protect against hazardous dusts and light liquid splashes are manufactured from fabric made from non-woven Polypropylene fibers. These fabrics are often known by the acronym "SMS" for Spunbond Meltblown Spunbond.

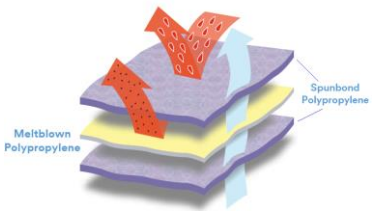

Figure 1. SMS Fabrics

SMS fabrics

The term "non-woven" simply means that the polypropylene fibers are neither woven nor knitted. Instead they are laid in layers that are either spunbond or meltblown.

The spunbond layers are the outer layers, and normally give the fabric its physical strength. In this process, pellets of polypropylene are melted inside an extruder. This melt is extruded through a die to make continuous filaments which are then cooled by a stream of air. As they cool they are laid down onto a wire mesh conveyer belt to form a random nonwoven layer of fabric.

The meltblown layers on the inside of the "sandwich" are intricate webs of microfibers that help filter out many water based chemicals and dry particulates to give the fabric its protective properties.

Although the fabrics are often collectively known as SMS they may have more than one layer of meltblown on the inside, or even more than one layer of spunbond on the outer side (Figure 1).

SMS fabrics used in the 3M™ Protective Coverall range typically vary in weight from 43 grams per square meter (GSM) to 54gsm. SMS fabrics are very breathable and can be treated by special processes to give them additional protective properties such as a greater level of chemical protection, a limited degree of flame spread resistance, or to help reduce the buildup of static electricity.

Bonding SMS fabrics can be achieved in several ways but a typical method for chemical protective fabric is thermo-bonding. In this process the layers of fabric are fed through two rollers. One roller has a smooth surface and the other has small pins mounted on it. This creates an embossed finish on the other side of the fabric. These pins only penetrate about 20% of the way through the fabric and help the layers to bond.

LAMINTED FABRICS

Within the range of 3M protective coverall's two types of substrate are used.

1. A substrate made from a polypropylene non-woven to which a layer of polyethylene film is added. This type of fabric is used in the 3M™ Protective Coverall 4510 (Figure 3) and the 3M™ Protective Coverall 4570.
2. The second type of laminated fabrics uses a substrate made from what is known as a **Bicomponent** layer to which polyethylene film is laminated. This substrate, often called Bico fabric, is made from special fibers which have a polyester core and a polyethylene sheath. This fabric is used in the 3M™ Protective Coverall 4540+, 3M™ Protective Coverall 4545 and the 3M™ Protective Coverall 4565 (Figure 4).

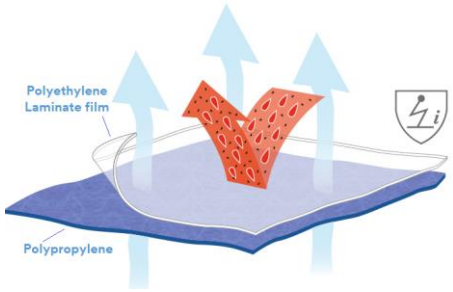

Figure 3. Breathable laminate on polypropylene as used on 3M™ Protective Coverall 4510

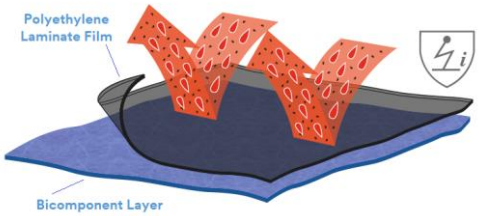

Figure 4. Non breathable laminate on Bico substrate as used on 3M™ Protective Coverall 4565

Laminated fabrics generally offer higher resistance to chemical permeation than SMS fabrics. The advantage of a Bico laminate compared to a standard laminate fabric is that it tends to be lighter, feel softer and have a better drape.

The weight of a laminated fabric in the 3M protective apparel range varies from around 47grams per square meter (GSM) up to 92 GSM. This variation is due to differences in the weights of both the substrate layer and the polyethylene film. Generally, the heavier the fabric, particularly of the polyethylene film, the higher will be the level of physical strength and chemical resistance.

Fabric treatments can be added to the fabric to give it enhanced properties. These may include a Flame Spread Resistant treatment, or a treatment to make the fabric more resistant to the build-up of static.

Breathability of fabrics is very important as non-breathable coveralls can inhibit evaporative cooling, contributing to heat stress. Laminate fabrics are generally less breathable than SMS fabrics. Fabric thickness and weight also have an effect on overall comfort.

3M uses our knowledge of fabric technology to design coveralls which help provide an appropriate level of protection and user comfort for a wide range of applications. For example, the 3M protective coverall 4545 is a Type 6 (and Type 5) coverall for protection against light splashes (and particulates), and is made using a microporous laminate fabric which is more breathable than the 3M protective coverall 4565 which is a Type 4 coverall for protection against sprays. The 4565 coverall is made from a fabric which is lighter than the 4570 coverall which meets the requirements of Type 3 for protection against jet sprays.

3M™ Protective Coverall 4545

3M™ Protective Coverall 4570

Another option when full laminates are not required is to use a combination or hybrid design of splash resistant laminate and breathable SMS fabrics. For example the 4535 coverall uses laminate fabric for the front of the body where the risk of splash may be higher, and SMS fabric for the back portions to help promote evaporative cooling and improved comfort.

3M™ Protective Coverall 4535

To find out more about the fabrics used in our range, or which 3M™ Protective Apparel solution best meets your needs visit **3M.com/protectiveapparel** or speak with your local 3M Application Engineer.

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