

INTERNATIONAL
**ENVIRO
GUARD**

MANUFACTURER OF
DISPOSABLE PROTECTIVE
CLOTHING

2023



INTERNATIONAL ENVIROGUARD

GUIDE TO PROTECTIVE CLOTHING SEAM CONSTRUCTION

Learn about different seam types for protective clothing and how they make a difference at your job site.

www.int-enviroguard.com

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ABOUT OUR COMPANY

For over 30 years, International Enviroguard has designed and manufactured an extensive assortment of disposable protective clothing and surface protection for a wide array of industries such as oil and gas, pharmaceuticals, construction, controlled environments, food processing, healthcare, agriculture, environmental remediation, and more.

INTERNATIONAL ENVIROGUARD PRODUCTS

- Body Filter 95+®
- Carpet Guard™
- ChemSplash® 1
- ChemSplash® 2
- Enviromat®
- GammaGuard CE®
- MicroGuard MP®
- MicroGuard CE®
- Polypropylene
- PyroGuard FR®
- PyroGuard CRFR™
- SMS
- Soft Scrubs™
- ValuGuard MP™
- ViroGuard®
- ViroGuard® 2



WE KNOW PROTECTION

International Enviroguard is the go-to supplier after a crisis. Our expertise in assessing protective needs and our nimble ability to deliver, has kept several essential teams safe after natural and man-made disasters. We are called in to support teams as they work on hurricane clean-up, infectious disease outbreaks and oil spills. Our ability to quickly identify and deliver the best protection for the job extends beyond these disasters to our entire operation.



WE DELIVER AFFORDABLE CONFIDENCE

International Enviroguard delivers engineered protection for the best total cost. We safeguard your people with a comfortable fit, performance and quality that can reduce waste and increase safety. We deliver more than products, we give you the power to reduce total costs, while enhancing protection and productivity.

WE CREATE A MORE COMFORTABLE WORKDAY

Comfort matters in the workplace. We design garments that shield you from pathogens, contaminants and grime while giving you the comfortable dexterity you need to do your job with confidence. Our innovative materials keep you cool, while our thoughtful design and sizing improve fit, wearability and ultimately, protection.

WE INNOVATE A BETTER EXPERIENCE

We are passionate about safeguarding what matters through innovation. Design thinking, flexible operations and an empowered culture drive our team to continually identify and solve new challenges. From optimal fitting garments and cooler fabrics, to advanced protection and user-driven product features, we engineer comfort and productivity in every inch.

LEARN ABOUT PROTECTIVE CLOTHING SEAMS

Typically, when choosing PPE, you select an option based on the type of hazards it protects against (i.e., chemical-resistant, fire-resistant, etc.). But, what about the seams?

This guide takes a dive deep into PPE seam types for protective clothing, so you can understand how they work and why they're essential for certain applications or environments.

Why Do Clothing Seams Matter for Personal Protective Clothing?

Not all seams offer the same level of protection against certain hazards, which is why it's important to understand how each type functions. More importantly, understanding how these seams are made can help you make the right decision for your job site and workforce.

Protective clothing seam types are specialized for use in personal protective equipment (PPE). These seams are designed differently than non-protective seams or seams used in "street clothes" for several reasons. Their mechanical strength is higher and protective seams are designed to prevent various substances from entering a garment such as chemicals, blood, or hazardous dry particles.

How Seam Construction Impacts Safety

The most likely route of contamination for a chemical is not permeation through the fabric but rather penetration through small holes in the suit, gaps between the suit and other PPE, or weak construction points of the suit (i.e. seams tearing apart or loosening).

For disposable chemical protective clothing, there are typically four different seam styles:

- **Serged**
- **Bound**
- **Welded (either ultrasonically or via high heat)**
- **and stitched and taped (includes double-taped and stitched)**

Only "welded" and "stitched and taped" seams provide a liquid-tight seal. Even if the fabric offers the highest resistance to liquid permeation, if holes are present in the seam or there are gaps between the protective clothing and other PPE, then a chemical will more readily and easily run through those rather than permeate the fabric.

Due to two principles, even tiny holes can have disproportionately large effects: **the bellows effect for dusts and the "wicking" process for liquids (covered on the following page).**



UNDERSTANDING WICKING & THE BELLOWS EFFECT

Wicking and The Bellows Effect

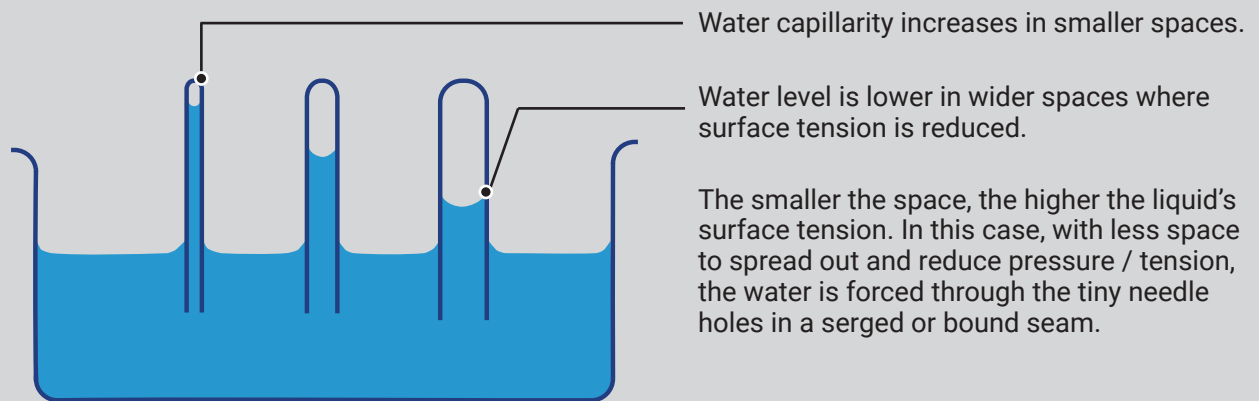
Wicking, also referred to as “capillary action,” describes the physical process of a liquid being actively drawn through a tiny opening due to its surface tension. As a result, even though a hole may be extremely small— for example, a stitch hole in a serged seam—the volume of liquid that ultimately penetrates may be considerable.

The Bellows effect is a critical factor in the prevention of hazardous dry particles from entering a garment. Dust, unlike liquids, floats freely and will only be able to penetrate a garment through air-flows, which are created by the construction or assembly of the garment. Therefore, the tendency of the garment to produce air-flows through gaps or holes (e.g. zip holes, seam holes, or gaps between the garment and other PPE) is a key factor in determining how effective a garment is at preventing dust ingress.

According to Bellows Effect, a fabric that is not breathable will create greater air-flows through gaps like seam holes than a fabric that is breathable. This is because air flows more easily through a breathable fabric. A breathable fabric has a lower tendency to create these air-flows. This means that a garment made of a breathable fabric can provide better overall dust protection compared to a similar garment made of a non breathable material, although the latter fabric may have better particle filtration.

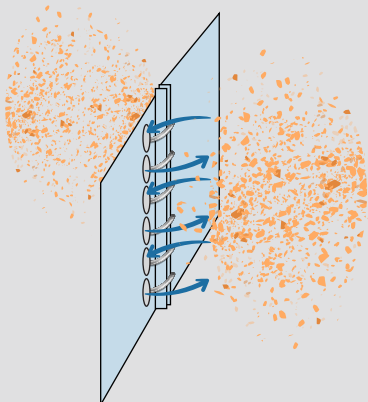
The combination of these factors demonstrates how seam structure and chemical resistant clothing interact with other PPE and may be as significant as, if not more important than, the fabric’s permeability.

Wicking or Capillary Action

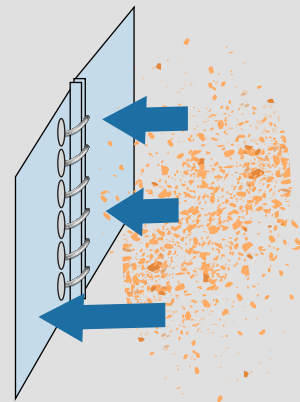


The Bellows Effect

Non-air-permeable fabric: Airflow created through seam holes pulls dust through them because it cannot penetrate the fabric.



Air-permeable fabric: Air passes through fabric; dust particles are filtered by the fabric, no airflow through seam holes.



UNDERSTANDING SERGED SEAMS

Serged or “Stitched” Seams

Best Used For: Low-level chemical and flame exposure, such as CE types 5 and 6

A serged seam, also known as an overlocked seam, is the simplest seam type. It is a stitched seam that uses either three or four threads to join two pieces of fabric together with an overlocking stitch.

This type of stitching is more resilient than what you'd find in regular “street clothing.” Although it is the simplest seam type in protective clothing, it can hold fabric together to resist light liquid splashes and dry particulates.

Serged seams are the least protective garment seam type, because the process of stitching creates small needle holes that can allow dust and chemicals to enter the garment. This seam construction does not provide a full barrier to liquids or dry particulates. Serged seams are suitable for basic protective suits that provide light splash and dry-particle protection (EN 943 Type 5 and 6 suits). Serged seams are not sufficient for garments intended for directional jets of spray or spray under pressure.

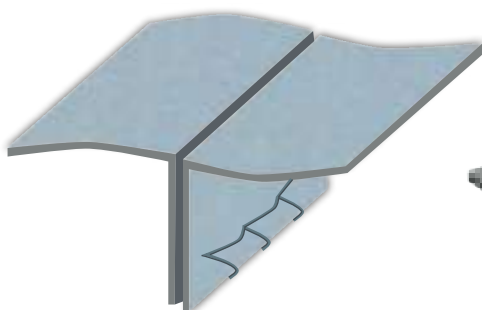
Advantages and Disadvantages

Serged seams offer better breathability, making them ideal for most job sites with low-level hazard exposure. PPE with this seam is also more cost-effective since it requires fewer materials and manufacturing.

However, serged seams can come undone over time. For example, if a worker wears too small PPE, they can put extra stress on the hem, causing it to split. If this happens, the garment should be replaced immediately.

A stitched seam, whether bound or serged, is not sealed; it has tiny stitch holes that are prone to open under stress (a problem worsened by tight fitting garments) and may allow more liquids or dusts into the garment. Therefore, when an application involves liquids or particulate hazards that can be harmful in small amounts, users should consider whether a garment with sealed seams (not serged or bound) should be used instead.

Serged seam top view



Serged seam bottom view



Advantages



More breathable



Stronger seam construction than what is used in “street clothes”



Most cost-effective



Can resist light liquid splashes and dry particulates but NOT FULLY due to Wicking & Bellows Effect

Disadvantages



Least protective seam used in protective clothing



Does not provide a full barrier to liquids or particulates; limited barrier protection (NOT SEALED)



Not suitable for directional jets of spray or spray under pressure

UNDERSTANDING BOUND SEAMS

Bound Seams

Best Used For: Low-level chemical and flame exposure (CE levels 5 and 6)

A bound seam is similar to a serged seam, however it offers an extra layer of protection by sewing a strip of fabric over the top of the two edges of the fabric to bind it together. This helps increase the level of holdout against leakage of liquids or dust particles. It may also help reinforce the seam for added seam strength. Bound seams provide a higher degree of liquid and particle repellency compared to serged seams, but they are also not liquid-tight.

Advantages and Disadvantages

Bound seams are still affordable, and they don't come undone as quickly as serged seams. Bound seams can still come undone, particularly if the clothing is too tight and movement is restricted. They're less breathable as a result, so workers may worry about overheating if the job site is hot.

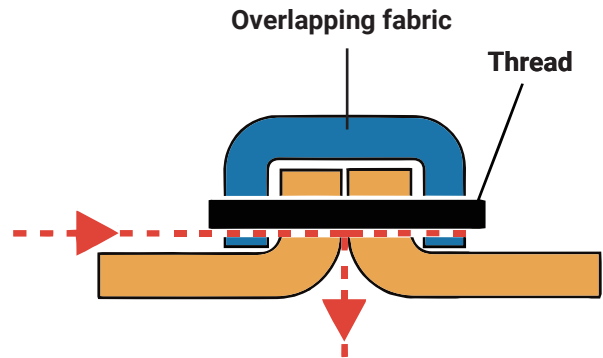
Although these seams are more resilient, they're not strong enough to warrant exposure to higher CE or fire hazard levels since they're not sealed completely.



Bound & serged seams are not fully sealed. They can allow liquids and particulates to enter a garment through seam holes created by needles, zipper holes, or gaps between protective clothing and other PPE.



BOUND SEAM DIFFERENTIATORS



Bound seam construction showing stitch holes & possible routes of liquid or dust ingress.

Advantages



Higher durability than serged seams

An added strip of fabric is sewn over the top of the two edges of fabric to bind it together, helping to reinforce the seam.



Higher liquid & particulate repellency than serged seams

The added fabric strip over the seam adds an extra layer of defense against liquids and particulates.



Cost effective

Bound seams are a simple construction. They use less materials to produce.

Disadvantages



Not fully sealed

Bound seams both have holes from where the needle and thread pass through i.e. stitch or needle holes. These holes can allow contaminants to penetrate or wick into the garment.



Not as breathable

The added fabric covering the seam can decrease breathability.



Can come undone with stress on the seams

If the seam is under stress, it can come apart. This can also pull the needle holes open more, providing an even wider path for contaminants to enter.

LEARN ABOUT STITCHED & TAPED SEAMS

Stitched/Serged and Taped Seams

Best Used For: High-level flame and chemical exposure (CE 1 to 4)

Stitched and taped seams, also known as over-taped seams, are serged seams that are sealed under a layer of tape. This seam construction is liquid-tight, making it suitable for use in Type 3 and Type 5 chemical suits. Of the protective clothing seam types used, stitching and taping a seam provides the optimal mix of a flexible and functional seam while maintaining an impervious seal.

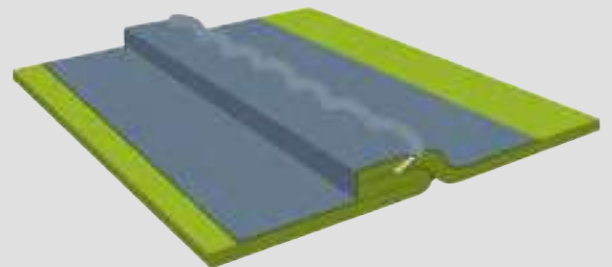
Taped seams act as a barrier to seal off any gaps or holes in the stitching of the suit. When workers are exposed to toxic chemicals and fire, they need sealed PPE that won't allow dust, sparks, or liquid to seep through the seams. Taped seams prevent seepage by covering the stitching underneath.

The tape covers the seam where the two edges of fabric are sewn together to provide the highest level of inward leak resistance. Tape is chosen based on a similar chemical resistance and impermeability to the fabric the coverall is made of.

Single-taped PPE uses one layer on the inside, which fills in the small holes left by serged seams. The tape is applied by using heat or ultrasonic sealing to create a complete seal that won't come undone or peel at the edges.

Advantages and Disadvantages

Taped seams are required in high-hazard areas, so having PPE with this seam style allows you to safely send workers into these environments. Taped seams are a bit pricier, but they last much longer. These seams are also more resistant to stretching and splitting since the tape won't peel off with normal wear and tear and completely covers the seam. A disadvantage is that they're not breathable, so workers need to be conscious of heat stress.



UNDERSTANDING DOUBLE-TAPED & STITCHED SEAMS

Double-Taped and Stitched Seams

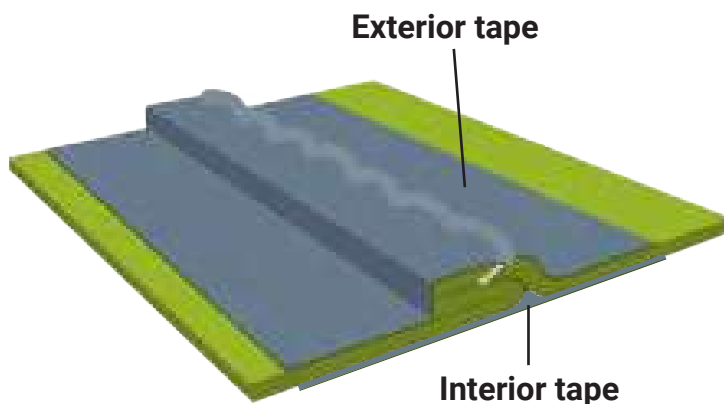
Best Used For: Areas with gas hazards, as well as high-hazard chemical and fire exposure

Rather than using a single layer of tape, this clothing uses two layers - one on the inside of the garment and one on the outside of the garment. This ensures the seam is sealed off on both sides of the garment. The process is still the same, meaning that the tape is heat-sealed so that it will not peel off.

Double-taped suits are used in gas-tight suits (Type 1 and Type 2 suits).

Advantages and Disadvantages

With two layers of tape, this PPE can work well in areas where ultra-fine particulates or toxic gas may be present. These suits can be more costly than others due to the additional materials and heat-sealing required.



Advantages



One of the most protective seam constructions



Seams are fully sealed providing gas-tight protection



Fully-sealed seams offer ultra-fine particulate protection



Seams can withstand directional jets and liquids under pressure

Disadvantages



One of the more costly seam constructions



Less breathable



Heat stress is a higher risk with double-taped seams

LEARN MORE ABOUT ULTRASONICALLY WELDED SEAMS

Ultrasonically Welded Seams or “Heat Sealed” Seams

Best Used For: High-level fire and chemical hazards (CE levels 1 through 4)

Typically, sealed seams require a two-step process. First, sewing the seam and second, taping it. Welded seams can create a similar seal with just one step.

Instead of a "butt" seam, as you'd find with the other varieties, welded seams use a lap stitch. This stitching is flatter, smoother, and less noticeable. Once finished, the stitching is "welded" together with heat to create a tight seal. This seam construction is also commonly called a "heat-sealed" seam.

Advantages and Disadvantages

Welded or heat-sealed seams are more expensive, and they're not always 100-percent effective. The problem lies in how much the seam is welded. Too much heat can make the material brittle, meaning the seam can split more easily allowing contaminants to seep in. With too little heat, the sides of the seam won't bond together correctly leading to an improper seal.

Unfortunately, it's almost impossible to spot these issues visually, and rips can develop from normal wear and tear over time. So, using welded seams can be effective, but keep these drawbacks in mind when purchasing protective clothing.

International Enviroguard Ultrasonically Welded Products



#2804
Blue 3 Layer, Latex-Free
Disposable Mask

2,000/CASE



#2804B
Black 3 Layer, Latex-Free
Disposable Mask



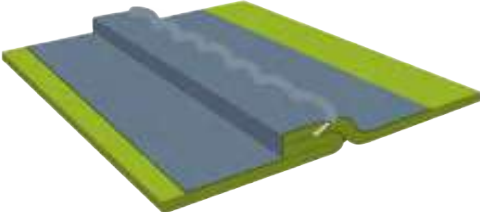
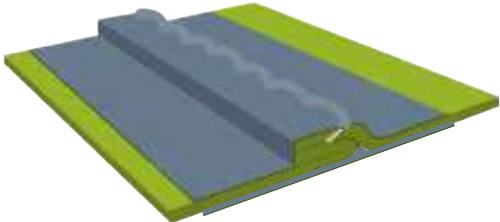

2,000/CASE



#IT6CAB-C
Blue PVC Cleanroom
Chemical Apron, with Long
Sleeves, Ties at Neck and
Waist, and Double-Sealed
Tunnelized Elastic Wrists

18/CASE

CHART DETAILING SEAM CONSTRUCTION OVERVIEW

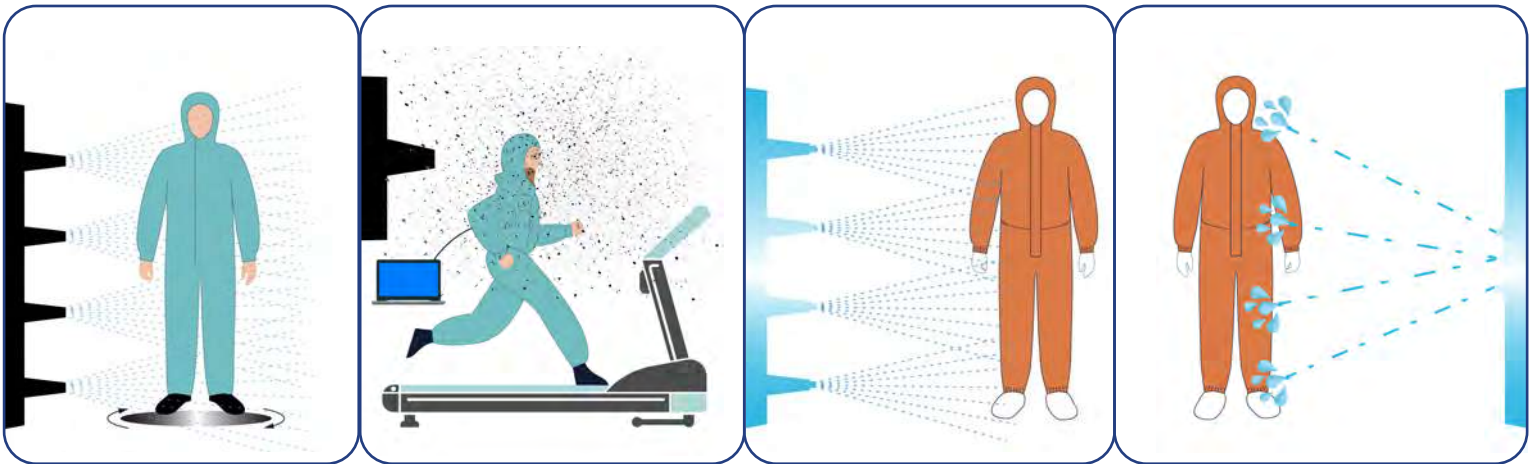
Seam Type	Image	Sealed?	Description
Serged or Stitched		NO	<p>Two fabric pieces are joined together using an over-locking stitch. This seam type leaves needle holes in the seam, which a liquid or dust can penetrate.</p> <p>An ill-fitting garment (too small) can put more stress on the seams, causing the holes to open up more. This can lead to a greater likelihood of contamination.</p> <p>Suitable only for low hazard chemical protection (CE Types 5 and 6)</p>
Bound		NO	<p>A strip of fabric is wrapped and sewed around the “butt” of the seam where the two fabric pieces join. This additional strip of fabric can help strengthen the seam and help reduce the possibility of liquid or dust penetration.</p> <p>Bound seams do have needle holes and are NOT a sealed seam.</p> <p>Suitable only for low hazard chemical protection (CE Types 5 and 6)</p>
Stitched & Taped		YES	<p>The seam is stitched and then a piece of impervious tape is applied OVER the seam and is sealed in place using heat. This seam type is fully sealed and impervious to penetration because the tape seals all holes created by the stitching.</p> <p>Used and required for all garments for higher hazard chemical protection (Types 1 to 4).</p> <p>The tape used must be an impervious film. Some garments use a woven tape which may not provide an impervious seal.</p>
Double-Stitched & Taped		YES	<p>The seam is stitched and impervious tape is applied to both sides of the seam—the inside and outside to provide a more secure and stronger seal.</p> <p>Used on higher level garments and gas-tight garments.</p>
Ultrasonic Welded		YES WITH CONDITIONS	<p>Fabric pieces are joined together in a “lap” rather than a “butt” seam. Ultrasonic (high frequency sound) is used to generate heat so the pieces of fabric melt and are welded together. This seam type can suffer from three problems:</p> <ol style="list-style-type: none"> 1. The combination of heat, pressure, and the speed of welding has a narrow window to produce a weld. It can easily be “overcooked” causing it to be inflexible and brittle, or “underdone”— it will not create a seal. This may not be visible, making it difficult to identify or control. 2. This seam can have reasonable tensile strength <i>across</i> the seam, it is often weak <i>along</i> the seam and will tear very easily once damaged. 3. This seam can have hairline cracks that are not visible, especially if “overcooked”. These could leak hazardous chemicals.

INDUSTRY & PPE

CE STANDARDS TYPES 3-6

Chemical protective clothing applications identified in CE Standards

The best way to understand the difference between suit Types 3,4,5, & 6 is to understand the differences between the finished garment tests used to assess them. Understanding garment tests means protection can be better targeted at your application.



Type 6

Light aerosol liquid sprays.

Type 5

Hazardous dust protection.

Type 4

Liquid chemical sprays.

Type 3

Liquid chemical jet sprays.

Seam Resistance to Permeation or Penetration Testing

There is no specific test in standards for Type 5 and Type 6 garments to measure seam penetration resistance.

However, finished garment Type Tests generate an assessment.

- A test subject enters a spray cabin wearing the garment and is sprayed with an aerosol spray, or for Type 5 garments the cabin is filled with dust particles.
- Any seams that open from stress or that become damaged can allow too much liquid or dust to enter the suit, preventing the minimum performance requirements from being met (test failure).
- As a result, any seam weakness(es) that occur from testing commonly lead to a failure of the test and a pass is required for certification.

For finished garments of Types 1 to 4, any seams that are not sealed would result in a fail. Furthermore, standards require permeation testing on a seam for at least one chemical with a result of at least Class 1.

INTERNATIONAL ENVIROGUARD PROTECTIVE CLOTHING SEAM TYPES

Serged Seam Brands



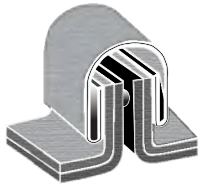
BRAND	DRY PARTICULATE, DUST, DIRT, GRIME	OVERSPRAY	HEAVY SPLASH, LIQUIDS UNDER PRESSURE	BLOOD-BORNE PATHOGENS ASTM F1671	BLOOD ASTM F1670	CHEMICAL SPLASH	SPARKS, FLAMES	ANTI- STATIC EN 1149-5
Body Filter 95+®	✓	✓						
ChemSplash® 1	✓	✓	✓		✓	✓		✓
MicroGuard CE®	✓	✓	✓		✓			✓
MicroGuard MP®	✓	✓	✓		✓			✓
Polypropylene	✓							
PyroGuard FR®	✓	✓					✓	✓
SMS	✓	✓						
Soft Scrubs™	✓	✓						✓
ValuGuard MP™	✓	✓	✓					
ViroGuard®	✓	✓	✓	✓ Fabric only	✓ Fabric only	✓		

INTERNATIONAL ENVIROGUARD PROTECTIVE CLOTHING SEAM TYPES

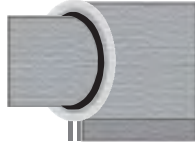
Bound Seam Brands

GammaGuard® CE

Suitable for ISO Classes 5-9



BOUND SEAMS



TUNNELIZED ELASTIC

ISO CLASS	ISO CLASS LIMITS†	FS209 CLASS LIMITS††	GAMMAGUARD® CE
ISO 3	35	1	
ISO 4	352	10	
ISO 5	3,520	100	✓
ISO 6	35,200	1,000	✓
ISO 7	352,000	10,000	✓
ISO 8	3,520,000	100,000	✓
ISO 9	35,200,000	—	✓

† (particles / m³ of air) for particles equal to and larger than 0.5 microns
 †† (particles / ft³ of air) for particles equal to and larger than 0.5 microns



TUNNELIZED ELASTIC WRISTS

contain particulate shed



PARTICULATE & LIQUID BARRIER
for dual protection



INDIVIDUALLY PACKAGED

helps to prevent cross-contamination



MADE IN ISO-13485 CERTIFIED FACILITY
for quality assurance



STERILE-DON™ PACKAGING
ensures loose particles are removed & coveralls are partially inside out for quick donning



CERTIFICATE OF STERILITY
included in each case



LOW-LINTING
to reduce particle shed



TEAR-RESISTANT
for enhanced durability



STERILIZED TO 10⁻⁶ SAL
for sterile work settings

GammaGuard® CE



INTERNATIONAL ENVIROGUARD PROTECTIVE CLOTHING SEAM TYPES

Stitched and Taped Seam Brands

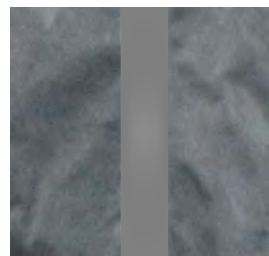
BRAND	DRY PARTICULATE, DUST, DIRT, GRIME	OVERSPRAY	HEAVY SPLASH, LIQUIDS UNDER PRESSURE	BLOOD-BORNE PATHOGENS ASTM F1671	BLOOD ASTM F1670	CHEMICAL SPLASH	SPARKS, FLAMES	ANTI- STATIC EN 1149-5
ChemSplash® 1	✓	✓	✓		✓	✓		✓
ChemSplash® 2	✓	✓	✓	✓	✓	✓		✓
PyroGuard CRFR™	✓	✓	✓			✓	✓	✓
ViroGuard® 2	✓	✓	✓	✓ Fabric & seams	✓ Fabric & seams	✓		



ChemSplash® 1



ChemSplash® 2



PyroGuard CRFR™



ViroGuard® 2



SEAM CONSTRUCTION

CONCLUDING POINTS

Concluding points on seam construction:

- **Serged and bound seams are not sealed.** Both seam styles have holes from where the needle and thread pass through i.e. stitch or needle holes. These holes are effectively open pathways through which a liquid or dry particulate can enter a garment. This is especially true if the seam is under stress which pulls the holes “open” providing an even wider path for contaminants to enter. The thread itself can also be a route for liquid penetration because thread often makes a great wicking medium that absorbs liquids. Because some penetration may occur, clothing with these seam types should not be used for protection against any chemicals that are harmful in small quantities.
- **Despite the fact that clothing with serged or bound seams (Type 5 & 6) can be certified to EN 14126, it's a better recommendation to use garments with sealed seams** (i.e., at least Type 4) to ensure there is no contamination through penetrable serged and bound seams.
- **Testing in CE certification requires certain seam constructions (sealed for Type 1 to 4) and also requires that seams in all certified garments meet / pass for the performance level.** Finished garment Type Tests are typically failed due to poor or inadequate seam construction.
- **When selecting a coverall, the seam construction should meet the protection level the coverall is intended to offer.** For example, a taped seam garment would likely be an unnecessary expense for a coverall designed to offer limited protection against light liquid splashes. Furthermore, a serged seam garment would not be suitable for protection against strong directional spray.

DISCLAIMER

The information provided is based on technical data and research that International Enviroguard believes to be reliable. All information is subject to revision as further knowledge becomes available. It is the user's responsibility to determine toxicity levels and the proper personal protective equipment needed. This information reflects the laboratory performance of fabrics under controlled conditions, not of complete “as-sold” garments. This information is intended for use by individuals with the technical expertise to evaluate their specific end-use conditions, at his or her own discretion and risk. Anyone using or intending to use this information should first check that a garment is suitable for the intended use.

Customers of International Enviroguard are solely responsible for conducting their own Hazard Risk Assessment to identify safety hazards in their work environment. Customers of International Enviroguard are solely responsible for selecting appropriate garments and personal protective equipment for their employees based upon known or potential hazards. Employers must ensure end-users properly use, care, and maintain their garments and personal protective equipment. An end-user should stop using a garment if the fabric becomes torn, punctured, or worn to avoid potential exposure to hazards.

As working conditions and other factors vary, International Enviroguard does not make or provide any warranties, expressed or implied, including but not limited to fitness for a particular use or purpose, and does not make any representation that these garments will protect end-users from injury. **INTERNATIONAL ENVIROGUARD DOES NOT ASSUME ANY LIABILITY IN CONNECTION WITH ANY USE OF THIS INFORMATION OR ITS PERSONAL PROTECTIVE PRODUCTS AND GARMENTS.**