



## This presentation is for informational purposes only

Customers of Bulwark Protection are solely responsible for conducting their own Hazard Risk Assessment to identify safety hazards in their work environment.

Customers of Bulwark Protection are solely responsible for selecting appropriate garments and protective gear for their employees and ensuring wearers use the garments and protective gear properly and in conjunction with appropriate gloves and footwear. Because working conditions and other factors may vary, Bulwark Protection does not make any representation that these garments and protective gear will protect wearers from injury.



# Welcome to our “Town Hall”

**Premise** — we receive a lot of questions around FR/AR clothing and not just on how to properly select, use, care and maintain clothing for the hazards. So we are going to do our best to answer some of them here – we did our best to leave the questions as asked.

## Some definitions

- FR/AR – flame resistant/arc rated garments
- Flame resistant – self-extinguishes; does not support combustion; does not melt, drip or add to the injury
- Arc Rated – tested to the electric arc flash hazard
- CP – Chemical Protection ([CP here only refers to Bulwark FRCP and CP garments](#)): repels small amounts of inadvertent liquid chemical splashes at atmospheric pressure



Flame-resistant garments protect those who are exposed to accidental thermal hazards







## Everyone talks about heat stress, but what do you do when it's cold (cold stress)?

The cooler temperatures create a new hazard for workers: cold stress. Similar to heat stress, this occurs when someone loses the ability to regulate their body temperature due to being exposed to extreme temperatures.



The FR/AR factor -

- Regardless of the hazard arc flash or flash fire, when discussing undergarments only natural fibers are allowed per the standards – no meltable fibers can be used in under layers.
- Layering of non-melting flammable garments is permitted to be worn under AR garments. **However, the arc rating of the outermost FR/AR layer must be sufficient to prevent break-open and ignition of the flammable under layer. If the outer layer is not equal to or greater than the hazard, under layers must also be arc rated.**
- Moisture managing base layer, smart wool or fleece mid layer, moisture-resistant durable water repellent (DWR) finish outerwear (all AR).
- Sweating in cold environments – have the innermost layer have moisture-wicking properties, but must be natural fibers or FR because of your hazard.
- Getting wet from rain or snow – outer layer needs to be AR and include water repellency like DWR and be of a tight weave to reduce impact of wind.
- Mid layers are a challenge because removing the outer layer garment due to exertion/work load now makes that garment the outermost layer and it must be arc rated.



Discuss heat stress garments, including those that could be worn under FR/AR clothing (heat stress and layering).

Effective fabrics typically will be a combination of:



**Light weight** – Less insulating allows more heat release (radiation)

**Open Weave** – More air permeable; allows more air to cool and evaporate moisture (convection)

**Moisture Wicking** – Moves more moisture to the surface for the evaporative cooling (evaporation)



## Could you discuss options for lightweight FR clothing?



Yes, there are many options today utilizing a variety of FR engineering to obtain, first and foremost, the necessary protection – then light weight, moisture wicking, high air permeability and moisture vapor transfer (MVT).

### **CONSIDERATIONS:**

1. Light weight in and of itself is NOT an indicator of comfort.
2. Make sure moisture wicking is a property of the fiber blend and not a finish (all wicking finishes are temporary).
3. High air perm is also not an indicator alone of comfort (aka screen door).
4. MVT is measurable and is a property of the fabric, but it's not easy to achieve in FR/AR.



## Are there any new breathable material options?

Yes, manufacturers of arc-rated and flame-resistant fabrics have been on a quest for over 25 years to develop new fiber combinations in the best ratios to take advantage of all their positives and minimize their negatives. Other manufacturers have looked to partner with fiber and fabric developers looking for new and innovative ways to achieve the balance of protection, comfort and value.



### **REMINDER:**

The single fabric characteristics listed below in and of themselves do not relate to comfort – comfort is subjective:  
light weight, moisture wicking, high air permeability and moisture vapor transfer



Any problems with using the pest control chemical DEET on FRC?

DEET is HIGHLY flammable in an arc flash and/or a flash fire, both in the dry and wet form, and should not be applied to FR/AR clothing.



*Products containing DEET currently are available to the public in a variety of liquids, lotions, sprays, and impregnated materials (e.g., wristbands). DEET is designed for direct application to human skin to repel insects, rather than kill them.*



Do the fibers with the added fire retardant have the potential to be absorbed by the skin of the wearer, assuming the fabric is not used until the fibers have been cured? Does the fire retardant have the potential to be absorbed by the skin?



**The answer is no, when utilizing market proven products!**

Look for legacy fabrics purchased across multiple sales cycles, proven flame resistance durability to laundering, normal wear, and the environment for the service life of the garment.



# Are inherent garments better than treated garments?

The simple answer is NO!

The concern today is that the terms refer to **single fiber types**. How can today's many blends—that utilize combinations of some or all types of FR engineering—molecular, fiber and fabric level—be **called "inherent" or "treated"**?





The question has come up about wearing a compliant Bulwark FR shirt as the base layer (tucked in), a cotton hoodie over that, with a compliant FR jacket over the cotton hoodie. This had been a common practice, and we are looking for clarification.



If it does come out or is allowed outside the jacket, then it is the outermost layer and must be FR/AR. Can the jacket come up exposing the non-FR layer either through poor fit, excessive movement, or when zipped down?

Per the standards, sandwiching a natural fiber between an FR/AR shirt and an FR/AR jacket is not directly disallowed – however, the standards cannot cover every potential combination of FR/AR garments, non-FR natural fiber layers, and the weakness of those combinations.

As described above, a non-FR hoodie unnecessarily introduces concerns into an FR/AR clothing program that has gone to the extent of procuring shirts and pants, trained personnel on tucking in their shirts and pants, and provided FR/AR jackets. Why allow non-FR sweatshirts and/or hoodies into that ensemble?

The only way to mitigate ignition hazards of non-FR fabrics is for them to be flame resistant.



## Is there a mandated length of training required per session for each Qualified Person?



There is not a time requirement for the training in 70E or OSHA. OSHA says, "The degree of training provided shall be determined by the risk to the employee." NFPA 70E doesn't specify a time, but it is important that the training meet the needs of the audience.

If a worker got hurt by electricity and they weren't following safety-related work practices, OSHA would say they weren't trained. So the employer has to provide enough training to prevent this. How much training? The employer has to decide.



## What about undergarments—specifically, our female employees' undergarments?

Yes, all the standards that speak to an FR/AR outer layer (ASTM 1506, NFPA 2113 and 70E) speak to undergarments, and they all say basically the same thing—they can be non-FR but cannot melt, drip or add to the injury, thus must be natural fibers, such as cotton, wool or silk.



The concern is finding 100% natural fiber undergarments—even white T-shirts can be 80/20, 50/50, etc.

Having undergarments made of FR fabrics can eliminate two main concerns:

1. undergarments that are blended with synthetics
2. outer layer failure leading to undergarment ignition

Specific to female employees, ensure that bras do not contain any metal supports or meltable fibers such as lycra, spandex, etc. There are Nomex and FR modacrylic sport bra style options available.



My department has recently encountered a few instances where employees have had a joint sprain (shoulder sprain, knee sprain and ankle sprain). How much concern should we have with employees wearing a non-FR, synthetic material brace under FR clothing?



An incidental amount of elastic used on non-melting fabric underwear or socks shall be permitted. (70E – 2018, 130.7-pg.30)

NFPA 2112 – 15 pg. 8 - has similar language - 5.1.10 Flame-resistant or non-melting undergarments (closest to the skin) shall be used. An incidental amount of elastic used on non-melting fabric underwear or socks shall be permitted.

In addition, have the brace free of metal and of medical grade (neoprene - NOT compression braces like “Copper Fit” etc. ) Purchase a long-sleeve base layer to have the compression device over top of the FR base layer and underneath the arc-rated shirt. Wear back braces the same way - over top of the FR base layer and underneath the shirt.

We don’t want to introduce a hazard or a meltable into the situation. Layering and having the brace made of medical-grade (thick) materials should minimize any chance of additional injuries from an arc flash exposure beyond what would occur without the “brace” in place.



Are there FR/Arc concerns in relation to accessories like belts and/or suspenders? I cannot come up with any decent literature discussing this topic.

This is a good question as there are few guidelines around accessories like belts, belt buckles, suspenders. You cannot find belts, belt buckles, or suspenders mentioned in ASTM 1506, NFPA70E and/or 1910.269. So, what do we know? Leather is very resistant to thermal energy – we allow leather footwear and leather protectors for rubber gloves, and though we don't directly address belts, leather would be the appropriate choice.



Suspenders are not as easy an answer. As with belts, they are not addressed in the standards. We do know that the density of non-FR materials assists them in resisting ignition – we see this in testing fall harness per *ASTM F887, Standard Specifications for Personal Climbing Equipment* where we test to determine if the material is arc resistant (note: not arc rated). The problem comes when writing your internal policy – what materials are ok? What thickness of material? What brand of suspender will not ignite, melt and/or drip, causing potential injury? I have not seen any suspenders claiming they have been tested to arc flash.



Employees are required to wear safety reflective vests over their FR/AR clothing. How does this compromise/affect the clothing, and what can be a solution?



Non-FR/AR vests will ignite, melt, drip and add to the injury. Many vests are not tested to the arc flash or flash-fire hazard, nullifying the investment you have made in your FR/AR clothing program. The regulations and standards do not allow non-FR/AR vests.

Reflective vests are now the outermost layer and must be FR/AR – see ANSI 107 2015: the updated standard requires vests to meet at least one of 5 standards, ASTM, 1506, 2733, 1891, NFPA 2113, 1977

The most common are vests with an arc rating and meeting ASTM 1506. Others will be available for NFPA 2112 flash fire hazards as the manufactures complete the testing/compliance requirements.



In laboratory environments, what options are available for combination FR and chemical resistance (CR) exposures?

Many chemical protective garments are flammable and **should not be worn** when fire is a hazard.



Use lightweight lab coats and coveralls that have flame-resistant properties provided by Nomex IIIA and chemical splash protection (ShieldCXP technology).



## What types of statements would you expect to see in the manufacturer's guarantee? (what is the life of the garment)

The responsibility of Bulwark is that flame-resistant apparel carrying our label will meet the performance requirements of the specifications and standards as stated on the garment labels and in our product literature. As long as our laundry instructions are followed, the flame resistance of Bulwark garments is **guaranteed for the life of the garment.**



### WHAT IS THE “LIFE OF A BULWARK® GARMENT”?

Bulwark® guarantees that our reusable garments will retain their flame-resistant properties for the life of the garment as long as our recommended laundering guidelines are followed. The life of a Bulwark® garment is not defined by the age of the garment, the number of times it has been worn or the number of times it has been laundered.

A Bulwark® garment is removed from service for the same reasons as everyday clothing: it no longer fits comfortably; it is contaminated with a flammable substance that cannot be completely removed; there are stubborn, unsightly stains; it has become threadbare. Finally, if a garment has rips, tears or holes which cannot be repaired, it must be removed from service.



## Do you know of a quality FR glove that is also cut resistant? (specialty FR)

Yes, there are manufacturers of arc-rated and flame-resistant gloves = Kevlar is FR and cut resistant



<https://www.superiorglove.com/en/dexterity-flame-resistant-arc-flash-glove-with-neoprene-palm>

<https://ytgloves.com/cat-flame-resistant>

<https://www.ansell.com/us/en/products/activarmr-80-813>

### Caution....

1. Match to the hazard (chemical, cut, arc, flame, impact)
2. Arc Rated
3. Shock Protection
4. Beware of meltables



## How do we know our visibility garments are still functional to meet visibility requirements?

The truth is you don't unless you are willing to test for chromaticity and luminance. In the real world, most ANSI garments are out of compliance shortly after they are out of the box – due to dirt, grime, grease, oils etc. on the high-visibility safety apparel (HVSA).



**Fluorescent material:** Material that instantaneously emits optical radiation within the visible range at wavelengths longer than absorbed and for which emission ceases upon removal of the source of irradiation. These materials enhance daytime visibility, especially during dawn and dusk.

**Photometric performance:** The effectiveness of retroreflective material in returning light to its source, measured in terms of coefficient of retroreflection.



Can you clarify if Bulwark arc-rated apparel is treated with chemicals to become arc rated? There is a rumor at my company that this clothing is treated with formaldehyde.



The chemistry utilized in creating FR/AR cotton-rich products is polymerized and bonds with the cotton fiber through a chemical reaction. The Occupational Safety and Health Administration (OSHA) in 1987 reduced the exposure to formaldehyde from 3 ppm to 1 ppm (0.1%) as the reporting threshold. In May 1992, the standard was amended, and the formaldehyde exposure limit was further reduced to 0.75 ppm. To your question concerning formaldehyde on Bulwark garments, there are small amounts left over on the fabric. These amounts are classified as “trace” (less than 0.75 ppm) and will be reduced even further after laundering.

Bulwark emphasizes the safety of our wearers and employees by utilizing only proven fiber and fabric supply chain partners. For over a quarter of a century, our FR cotton-rich fabrics are and have been utilized by hundreds of thousands of wearers and are cut and sewn in our facilities by our employees every day.

# Thank you



**Any additional questions, any  
comments, feedback?**