



Why Is FR/AR Compliance so Difficult?
Or are we just over-complicating things?

Meet Your Speaker

Derek Sang
**SENIOR TECHNICAL TRAINING
MANAGER**

With over 25 years of experience in the Flame-Resistant clothing industry, In this role, he has developed over 40-hours of training for Bulwark University, covering all aspects of Flame Resistant and Arc Rated clothing. Derek's impact extends globally, as he has conducted 250+ educational seminars on the hazards of arc flash and flash fire through various platforms, including live events, webinars, and seminars. His expertise has positioned him as a recognized Subject Matter Expert in the proper selection, use, care, and maintenance of flame-resistant and arc-rated clothing, emphasizing their role as secondary Personal Protective Equipment (PPE).





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 personal protective equipment for their employees. Employers must ensure wearers use, care and maintain their garments and personal protective equipment properly. As working conditions and other factors vary, Bulwark Protection does not make any representation that these garments and personal protective equipment will protect wearers from injury.



Reminder to submit
your questions throughout by
submitting them in the question box.



Premise – We receive a lot of questions around ... “how do we help our people comply, how do they properly wear flame-resistant/arc-rated clothing?”, “What is better – task-based or daily wear?” and “How do we ensure our people will wear their FR/AR clothing properly?”

What you will take away....

- Why is there resistance to FR/AR?
- What are some best practices to improve “buy in” to your FR/AR program?
- How FR/AR science is leading to compliance.
- What are the pros and cons of daily wear vs. task-based programs?
- FR/AR clothing is not complicated – culture change can be.



Why is there resistance to FR/AR?

1. It's TOOOOOOOOOOOO HOTTTTTTTT!!!!
2. It's heavy and uncomfortable.
3. Doesn't fit well.

Safety then trends too *“They can just put it on when they need it”* - correspondingly that strategy hits all 3 of the resistors above.

- Putting a 7oz or 9 oz. coverall over top of 100% cotton work clothing - **HOT**
- Adding additional layers - **HEAVY**
- Coveralls – **Not designed to FIT WELL**



Encouraging compliance when it's HOT

What is the best way to encourage compliance when it's HOT?

The short answer is: **wear trials and training**

Single-layer FR/AR clothing does not trap heat or restrict heat removal any more than regular non-FR clothing. **May 1, 2019**
OHS – The Truth about Heat Stress and FRC

Heat is shed primarily by evaporation of sweat. Restriction or loss of this function either due to physiological conditions such as dehydration and/or clothing that restricts this action (such as raingear or impermeable membranes, or multiple layers), can contribute to heat stress.

TLV Clothing Corrections

Clothing Type	WBGT Correction
Work clothes (long sleeve and pants)	0
Cloth (woven material) coveralls	0
Double layer woven clothing	3
SMS polypropylene coveralls	0.5
Polyolefin overalls	1
Limited use vapour-barrier overalls	11



Encouraging compliance when it's HOT

How do I convince my people to tuck in shirts, roll down sleeves and button their garments up – they are always complaining it's too hot?

It is a challenge, but **“ALL”** the standards point to wearing shirts, pants and coveralls properly and by properly we mean sleeves rolled down, shirts tucked in and buttoned.

Our arc flash standards – NFPA70E and ASTM state:

NFPA70E - In addition to correct fit and appropriate freedom of movement, **sleeves must be fastened at the wrists, shirts must be tucked in, and shirts, jackets, and coveralls must be closed up to the neck.**

ASTM 1506 - XI.2.1 Clothing should cover potentially **exposed areas as completely as practicable. This should include proper interfacing of related items.** (The proper way pants and shirts (related items) interface is **“tucked in.”**)

Our Flash Fire standard NFPA 2113 –

5.1.6 When a shirt and pair of trousers, both flame-resistant, are worn together, the shirt **shall be tucked in.**



New material options?

Manufacturers are partnering with performance fiber and fabric developers looking for new and innovative ways to achieve the balance of protection, comfort and value.

REMINDER:

Single fabric characteristics in and of themselves do not correlate to comfort – comfort is the wrong goal *“light weight, moisture wicking, high air permeability and moisture vapor transfer”*.

Look for FR clothing that compliments the body’s evaporative cooling mechanism:

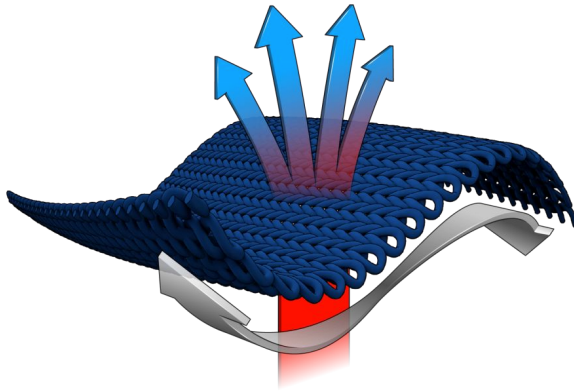
- Moisture wicking fibers (not a finish)
- Open weave to allow air permeability

Meaning....

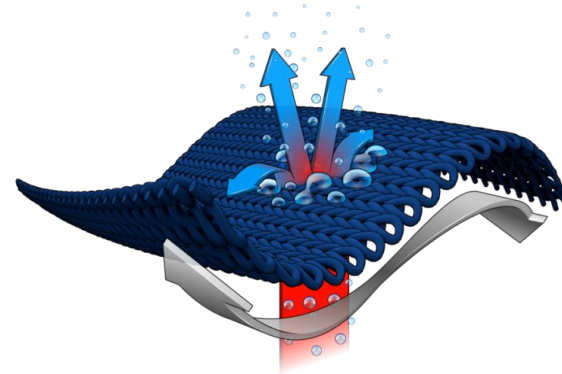
Reducing skin temp aka “cooling” has two 2 Key Elements!

And it is not weight dependent

AIRFLOW



WICKING



A unique combination of yarns
and an open weave construction
creates wicking and airflow
which drives cooling



Assisting compliance starts with the fabric

- **Enhanced protection:** advanced FR chemistry and enhanced fiber blends; making less do more
- Improved **moisture wicking:** dry almost twice as fast as cotton; less energy to dry
- **Open weave** driving increased **breathability;** also allows more water to get into the fabric to get the dirt out during cleaning
- **Durability:** superior **resistance to abrasion;** better ROI
- Improved **thermal regulation:** Mimicking the bodies evaporative cooling mechanism

Creating true performance workwear for the occupational athlete in the FR/AR market to defeat “comfort” objections to wearing my PPE



Lighter is more comfortable

Fabric Weight in and of Itself is NOT an Indicator of Comfort
Look deeper than just the brochure...

High air permability alone is not an indicator of comfort (aka a screen door)

Make sure moisture wicking is a property of the fiber blend and not a finish
(all wicking finishes are temporary)

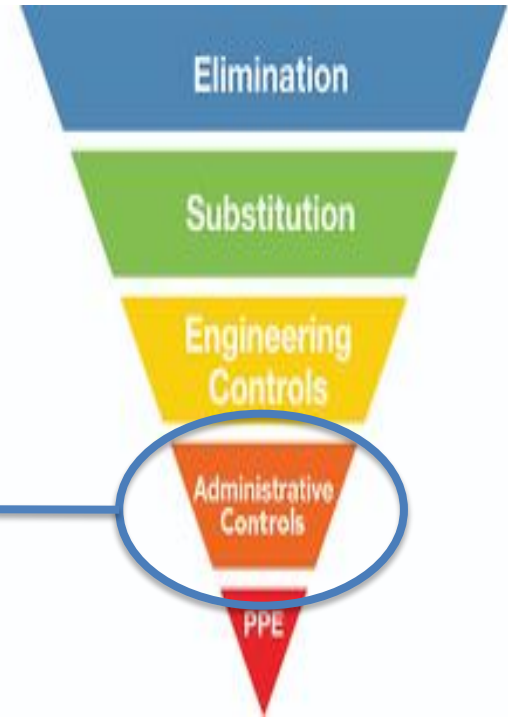
Remember: there must be a balance





So, what do we see in the field....

- Very little or no resistance to FR/AR below the waist – leads to....
- Adopting a task-based solutions – leads to....
- Over protecting – the PPE Category Method (aka CAT) method or flash suits – leads to...
- Not Wearing bulky cumbersome PPE – leads to
- The hierarchy of controls stopping at **ADMIN**





It hasn't happened to us....

Just because **NOTHING** has gone **WRONG** doesn't make what you are doing right or safe.

Compliance does not necessarily mean or equate to safety, though if you are safe, you are most likely compliant – think task-based vs. daily wear.



This is how it creeps into my world.....

Is this under shirt arc rated?
Is this shirt arc rated based on a reasonable estimate of the incident energy?

What is he wearing under his arc-rated shirt?
Is it potentially exposed based on the laws of thermodynamics?

Note: all the standards state shirts must be tucked into pants!





I Will Just Get Everyone A Hot Kit That Way They Will Be Safe

FACT? OR FICTION?

FICTION

Frequently we hear that employers have outfitted their employees with FR/AR coveralls for them to wear when doing energized work' the real question is: are they safe?

The simple answer is; NO, To be compliant: you are asking them to stop what they are doing and to remember to don their FR/AR coverall.

This is where task-based programs fail, especially if FR/AR clothing has not been part of their safety culture. Remember energized tasks as defined by NFPA70E are voltage testing, trouble shooting and verifying, tasks that may be considered routine or “not all that” dangerous by the electrician and thus not require “all that PPE”.



So where did it go wrong.... Tasked based

You have a program in place, and you gave everyone the necessary tools to get the job done. What happened?

- Someone takes a shortcut - saves them some time; set and repeat.
- Others see this and start to emulate it.
- New hires and transfers see this behavior and start to believe that:

“This is the way we do things around here.”

Next thing, the unsafe practice becomes ingrained



What Is Wrong With A “Task” Based

Approach

Let’s run the numbers:

You employ 10 electricians and each electrician does an average of 10 energized tasks a day, that is, 100 energized tasks a day, 3000 energized tasks per month and over **30,000 opportunities** a year for them not to have “it” on when they need it.

What about the cost in time to you the employer –

- 10 stoppages to change in and then out of their FR/AR coverall per day.
- Cost in time; 5 min to put on your coverall and another 5 min to take off your coverall. 100 min/day/employee.
- 1000 min/day times 30 days or 30,000 min a month (500 plus hours a month changing in and out of coveralls),
- **10 employees, that is at \$20 dollars an hour that will cost you \$10,000 a month**

daily-wear FR/AR clothing - for the large majority of energized work

- minimizes the cost of daily tasks
- minimizes the number of decisions
- Provides a baseline of protection
- **A \$1000/year/employee equals about \$0.42/hour or about \$35/day for your team of 10 electricians**



When Doing Wrong seems Right: Normalization of Deviance

When people routinely perform repetitive yet dangerous tasks, it is very easy to become desensitized to the inherent risk of what could happen. There are even terms for it: it is called “**unintended blindness**” and/or **insensitivity to hazards** of the job. Even to go as far as calling it –

Normalization of Deviance.

First coined by sociologist Diane Vaughan when reviewing the Challenger disaster.

Vaughan noted that the root cause of the Challenger disaster was related to the repeated choice of NASA officials to **fly the space shuttle despite a dangerous design flaw with the O-rings.**

Insensitivity occurs over years because catastrophic/disaster does not happen immediately.



NFPA[®] 70E Annex Q: Human Performance and Workplace Electrical Safety

People are fallible, and even the best people make mistakes.

Task Demands

- Time pressure (in a hurry)
- High workload (memory requirements)
- Simultaneous or multiple tasks

Work Environment

- Distractions/interruptions
- Changes/departures from routine

Individual Capabilities

- Unfamiliar with, or first time performing task
- Lack of knowledge (faulty mental model)

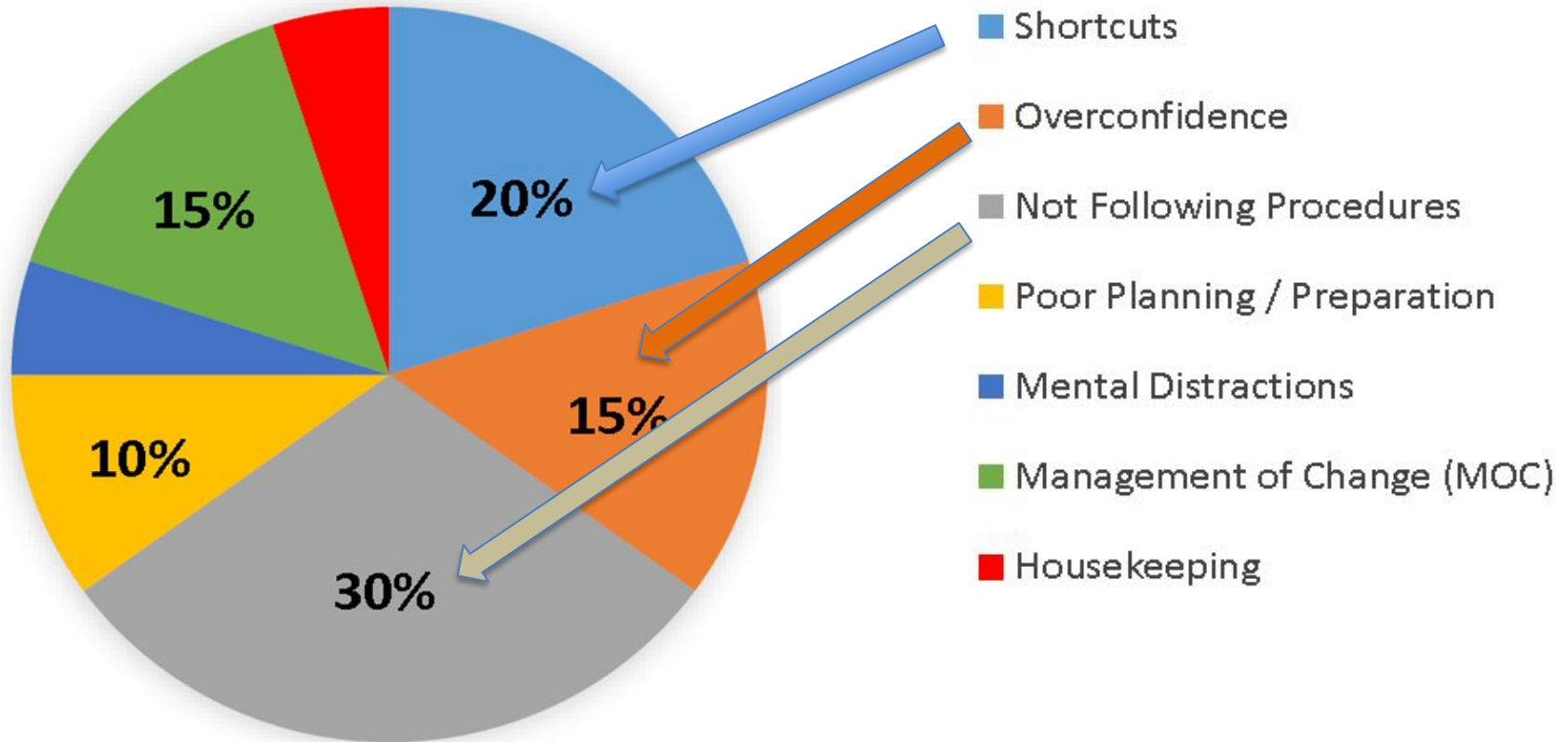
Human Nature

- Stress (limits attention)
- Habit patterns
- Assumptions
- Complacency/overconfidence

The annex discusses the concept of human performance “to identify and address human error and its negative consequences on people, programs, processes, work environment, equipment or an organization.”



Where does "HUMAN" show up on the job...



*Source: US Insurance Data



Combating “HUMAN”....

Daily wear is a baseline level of protection to combat not just human factors such as complacency, lack of sensitivity to the hazard and/or a normalization of deviance.

It also provides a last line of defense when - as exemplified in the hierarchy of controls - everything else fails.



Task-based vs. Daily Wear

Primary Protective Clothing

- Definition: “Clothing that is designed to be worn for work activities where significant exposure to molten substance splash, radiant heat, and flame is likely to occur.” Example- Firefighter Turnout Gear



Secondary Protective Clothing

- Definition: “Clothing that is designed for continuous wear in designated locations where intermittent exposure to molten substance splash, radiant heat, and flame is possible.” Example- Utility workers, Refinery workers

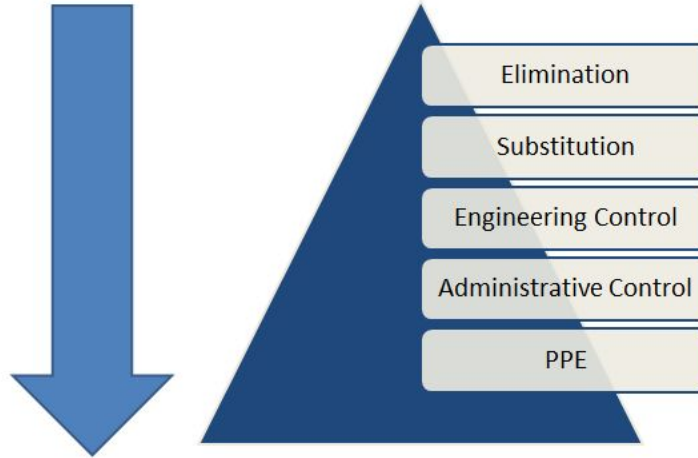


Hierarchy of Controls



What Flame Resistant Clothing is Not!

EFFECTIVENESS

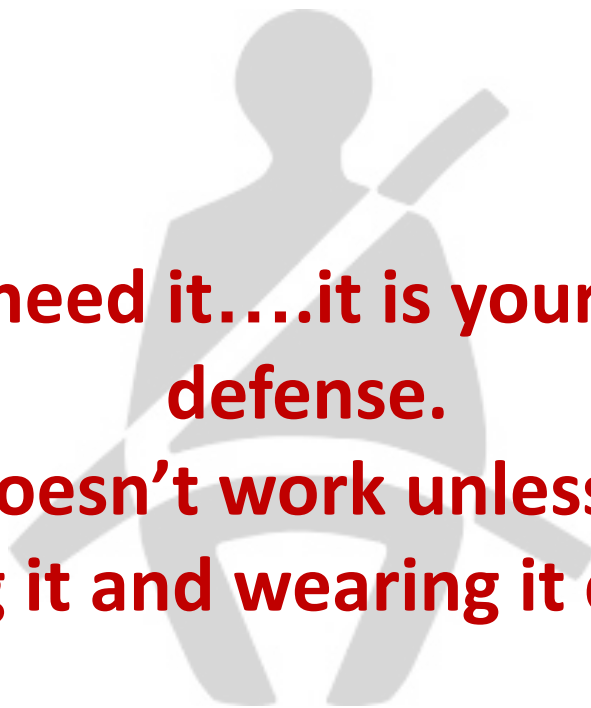




Better to have it and not need it than need it and not have it..

When you need it....it is your only line of defense.

And it doesn't work unless you are wearing it and wearing it correctly





Bonus....

SOME STANDARDS ALONE ARE NOT ENOUGH; SOME ARE JUST WRONG

Noncompliant rainwear and vest can pose a serious problem to an otherwise solid FR/AR clothing program

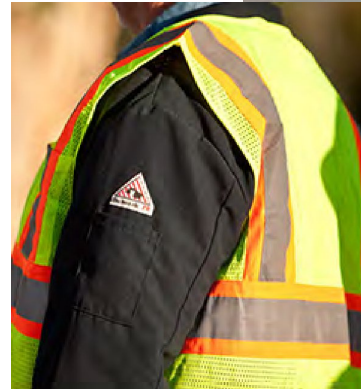
- ASTM F2302 – **NOT INTENDED AS A STAND ALONE**
- ASTM D6413 – **NOT A PERFORMANCE STANDARD**
- NFPA® 701 - **NOT A GARMENT STANDARD**

Rainwear has specific standards for arc flash and flash fire

ASTM 1891 – for arc flash

ASTM 2733 – for flash fire

For vests – look for ASTM 1506 and an Arc rating in the label





Misleading Labels

This is misleading and potentially dangerous! How many contradictions can you have in one label?

Notice what is large and bold vs. in small, hard-to-read print. You have to ask, what is the purpose?



Self-extinguishing characteristic that they state **wears out**

ASTM 6413 is **not** a performance standard

It has to state by ANSI 107-15 it is **non-FR** because it does not meet a performance standard for arc flash or flash fire

How can you say FR when on the same label you say it is non-FR?



Don't over complicate things...

Simplified:

- Daily wear
- FR/AR should be appropriate to hazard
- Base layers are important
- Upgrade to latest technology
- Do your homework
- Look to a SME you trust



How does that look for arc flash protection?

Wherever workers may be exposed to hazards associated with electrical energy, employers must make sure they are protected.

During an arc flash the amount of energy that could potentially be released is called Incident Energy or IE, and it is expressed in calories per square centimeter or cal/cm^2 .

NFPA 70E® requires AR (or arc-rated) clothing for any potential exposure **above $1.2 \text{ cal}/\text{cm}^2$**

OSHA 1910.269 requires AR (or arc-rated) clothing for any potential exposure **above $2.0 \text{ cal}/\text{cm}^2$**

AR clothing must be **matched** to the degree of severity presented by the Incident Energy (IE).

This is called an arc rating, which can be an **ATPV** (Arc Thermal Performance Value) or an **Ebt** (Energy Break open Threshold); both measured in cal/cm^2 .

AR > IE



Selection of arc-rated when the Incident Energy is known

Table 130.5(G)

Incident energy exposures equal to 1.2 cal/cm² and up to 12 cal/cm²

Arc-rated clothing with **an arc rating equal to or greater than the estimated incident energy**

A - Long-sleeve shirt and pants or coverall or arc flash suit **(Selection of one in group is required)**

Arc-rated face shield and arc-rated balaclava or arc flash suit hood **(Selection of one in group is required)**

Arc-rated outerwear (e.g., jacket, parka, rainwear, hardhat liner) **(As needed)**

Incident energy exposures greater than 12 cal/cm²

Arc-rated clothing with an arc rating equal to or greater than the estimated incident energy

A - Long-sleeve shirt and pants or coverall or arc flash suit **(Selection of one in group is required)**

Arc-rated arc flash suit hood

Arc-rated outerwear (e.g., jacket, parka, rainwear, hardhat liner) **(As needed)**

Arc-rated gloves or rubber insulating gloves with leather protectors **(Selection of one in group is required)**

Knowing the IE allows you to protect to the hazard vs. a range such as in the CAT Method



How does that look for flash fire protection?

Specify NFPA[®] 2112 Compliant garments:

What it is....

- A means of certifying fabrics, findings & facilities suitable for use & manufacturing FR clothing to be worn as protection against possible flash fire exposure

Fabrics must :

- Retain flame resistance through multiple launderings
- Meet standards for heat transfer performance, thermal stability and heat resistance
- Result in less than 50% predicted body burn when tested on a thermal manikin over underwear in a flash fire of 3 seconds



What does 3rd- party certified mean to YOU?

- Based on what we know today – it gives you peace of mind that this garment meets or exceeds all the standards and tests available for the hazard
- You don't need to choose NFPA[®] 2112-certified garments, but if you don't, why didn't you?
- If you are not going to use NFPA[®] 2112, what are you going to use?



When Should I Consider An Industrial Laundry

- ✓ High soil environment – higher water temps/stronger chemistry
- ✓ Contain contaminants – prevent from going home with employees
- ✓ Logistics make sense – close proximity to facility/service area
- ✓ Repairs and upgrades – single source
- ✓ High turnover – can manage bulk programs
- ✓ Simplified product line – coveralls a few shirts & pants with limited color options



When Should I Consider Home Laundering?

- ✓ Low to medium soil – little or no concern of contaminants going home
- ✓ Logistics are a challenge – employees do not return to a central location
- ✓ Low turnover – tenured employees minimize cost of outfitting
- ✓ Flexibility – not locked into terms and or technology
- ✓ Choice – can rapidly adapt to changes in technology/style

**The ability to mix and match programs within facilities/locations - NOG*



Don't over-complicate things...Team Buy-in

- ✓ FR committee
- ✓ Evaluate & select latest fabrics for garments
- ✓ Tour the manufacturer/mills
- ✓ Proper wear trial of garments
- ✓ Include outerwear, rainwear and Hi Vis
- ✓ Select: Choice, IL or Hybrid program
- ✓ Roll out must include training



It's Pretty Hard To Mess Up Good FR/AR

Asterisk ...this pertains to market proven suppliers and manufacturers**

FR/AR today regardless of the FR engineering or combination of FR engineering is that the FR/AR properties are for the life of the garment and are therefore durable to not just laundering but also wear and tear.

Thanks to regulations, standards and you the market:

- Extensive testing and development around protection, comfort and durability
- 25+ years of fiber and fabric innovation and development
- Market driving manufacturers to improve around comfort and durability - light weight, moisture wicking, high air permeability and moisture vapor transfer to create performance FR/AR workwear.



Thank You!

Questions & Discussion

Bulwark Protective Apparel

Derek Sang

derek.sang@bulwark.com