



Are You SAFE or Are You Just Being COMPLIANT?

Should You Implement a Daily Wear FR/AR Clothing Program?"

Derek Sang

Senior Technical Training Manager

#CRSCSafetyConference

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).





Before we begin...

Numbers... 99.99 - is that good?

Context:

At the age of 25, I step into this organization. I've surpassed the prequalification's both physically and mentally, I have undergone extensive training, I have demonstrated the skills required for every level of advancement and received comprehensive training on all the necessary personal protective equipment (PPE). Fast forward 10 years, and the result is remarkable—I stand before you, 99.99% successful at avoiding lost time injuries. So, is that good?

It can be considered so good; you might even get a note/letter or email like this...



Dear Employee....

"Reflecting on a decade of dedication and resilience, it's not just about the numbers; it's a testament to unwavering commitment – 99.99%. A remarkable statistic that encapsulates a journey from a 25-year-old recruit to a seasoned professional, proving that safety isn't just a goal; it's a way of life."

Thank you



Let's look at what 00.01% can look like...

Let's use my 10-year career:

10 to 12 games per season, spring ball, two-a-days, and weekly practices—resulting in approximately

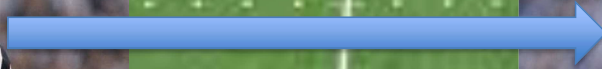
30,000 contacts.

Within those:

3,000 are considered high risk



Hi Impact/Hi Risk - 3,000 collisions at 10 miles an hour.



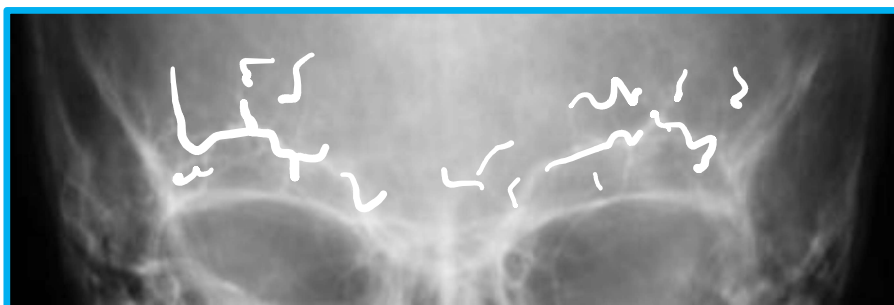


My 0.01% -

- 20 concussions
- 2 knee surgeries
- elbow surgery
- torn bicep tendon
- torn hamstring

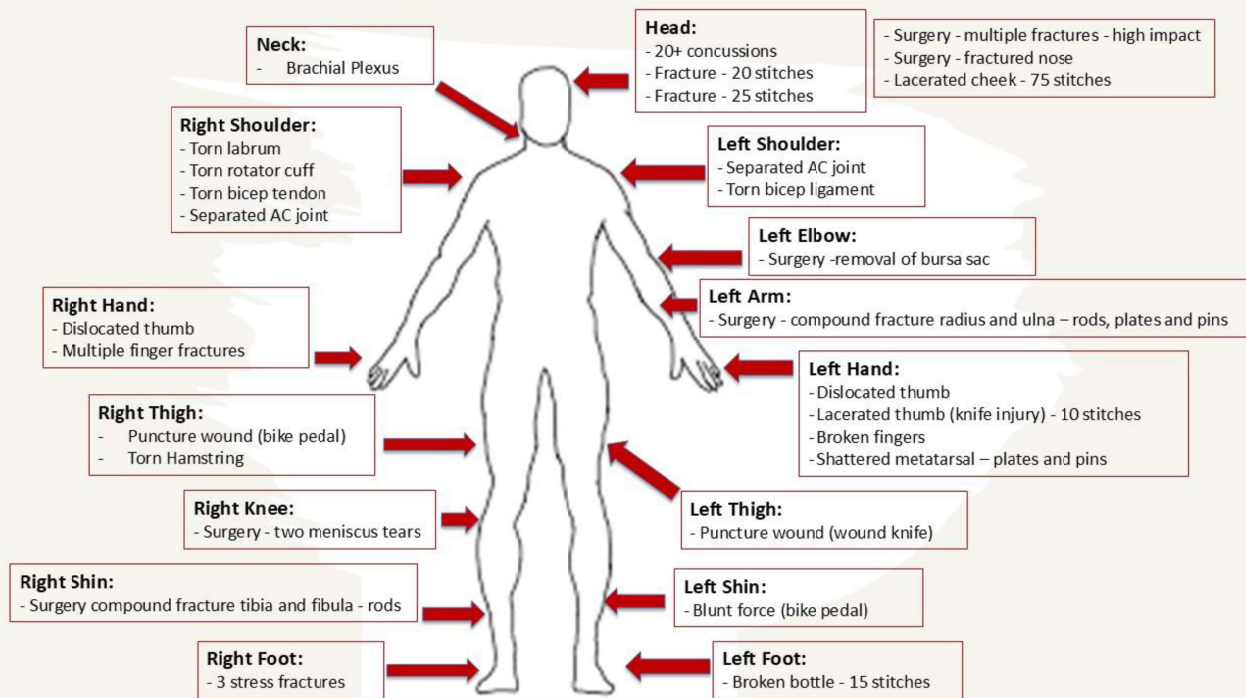
- 3 broken ribs
- broken/dislocated fingers
- 2 high ankle sprains
- knocked out twice

ALL LOST TIME INJURIES





Lifetime Injury Achievement.... Just the big ones



Is 99.99 good enough?

What will your 0.01% look like in 10 years?



Why am I here...Can Your Work Environment Change?

Electrical Hazards:

Electrocution: Contact with live wires is a major risk, potentially fatal.

Arc Flash: A sudden release of electrical energy, causing severe burns.

Working at Heights:

Falls: Working on poles, towers, and rooftops poses a significant fall risk.

Traffic Hazards:

Vehicle Collisions: Working near roadways exposes workers to the risk of being struck by vehicles.

Distracted Driving: Drivers may not see workers clearly, increasing the risk.

Confined Spaces:

Suffocation: Working in trenches, manholes, and other confined spaces can lead to oxygen deficiency.

Hazardous Atmospheres: Potential for exposure to toxic gases.

Excavation Hazards:

Cave-ins: Soil collapse can bury workers alive.

Struck-by Hazards: Falling objects or equipment.

Weather Hazards:

Extreme Temperatures: Heat stress or cold-related injuries.

Storms: High winds, lightning, and heavy rain can create dangerous conditions.

Exposure to Hazardous Materials:

Chemical Exposure: Potential for contact with harmful substances like asbestos or lead.

Ergonomic Hazards:

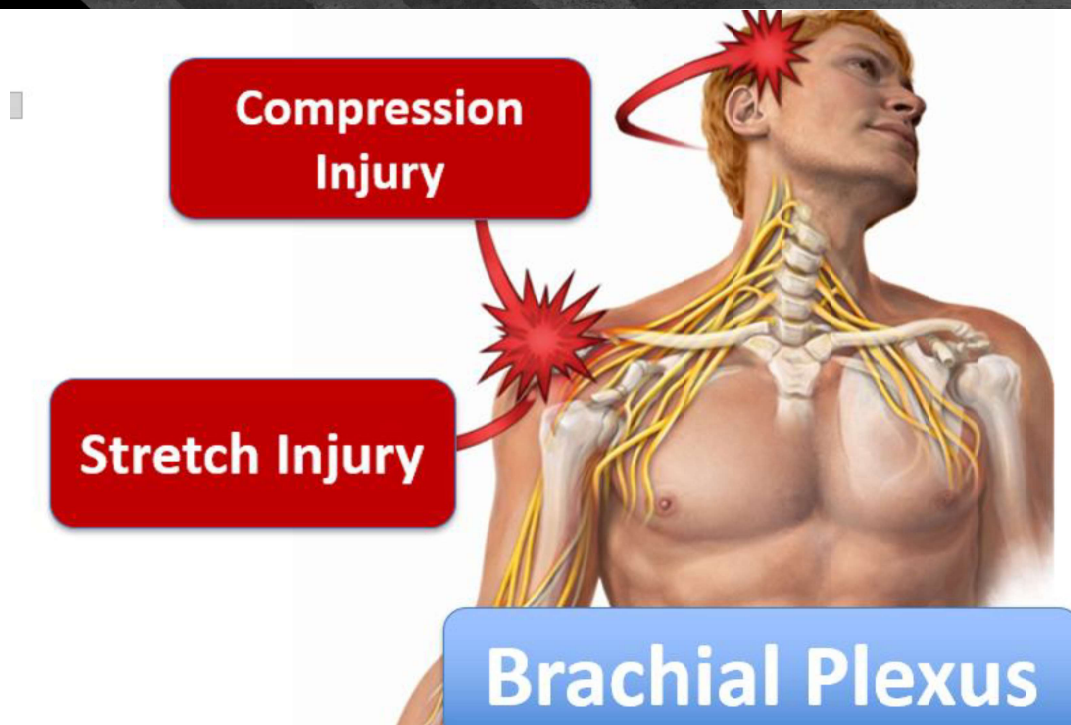
Musculoskeletal Injuries: Repetitive motions, heavy lifting, and awkward postures can lead to strains and sprains.

Equipment Hazards:

Malfunctioning Equipment: Faulty tools and machinery can increase the risk of accidents.



I Got Complacent....





Our talk today is about just one of those hazards....

The proper selection of PPE is very important.

Though thermal hazards may be different for different industries, the basics for selection, use, care and maintenance share many similarities.



RESPONSIBILITY: WHO IS RESPONSIBLE FOR WHAT?

When determining who is responsible for worker and workplace safety, it's important to note that most laws and regulations point to employers.

OSHA General Duty Clause – OSH Act 1970 SEC. 5. Duties

(a) Each employer --

(1) shall furnish to each of their employees' employment and a place of employment which are free from recognized hazards that are causing or are likely to cause **death** or **serious physical harm** to their employees;



Choosing the right PPE for the job

Employers choosing FR/AR clothing are required by OSHA to –

“Select, and have each affected employee use, the types of PPE that will protect the affected employee from the hazards identified in the hazard assessment.”

There is NO requirement that the garments be worn – all day

As with hazard assessment, industry consensus standards may be used to guide selection decisions. (ASTM, ANSI, NFPA)



Is the hazard arc flash?



FALSE : Clothing ignition is the real HAZARD and AR clothing eliminates the hazard

Why is Arc Rated PPE Needed?



- Almost all the severe burn injuries and fatalities are caused by non-flame-resistant clothing igniting and continuing to burn.
- In these circumstances skin under non-FR clothing is often burned more severely than skin exposed directly to the arc.



OSHA is the “**SHALL**”
Our **Standards** are the “**HOW**”

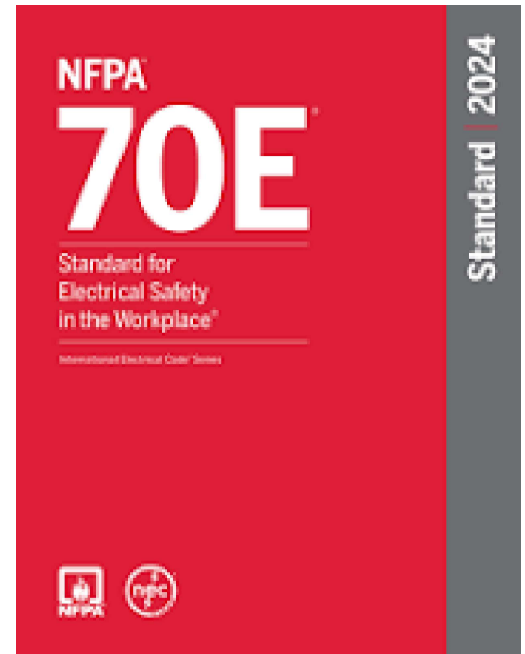
- Industry consensus standards, such as NFPA, ANSI, ASTM etc.. are used in OSHA enforcement actions as evidence as to whether the employer acted reasonably



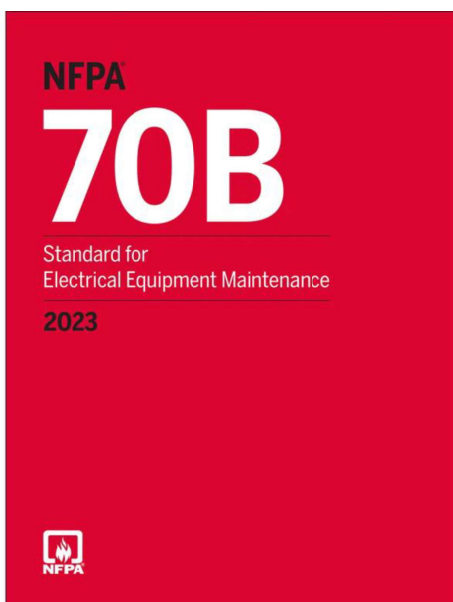
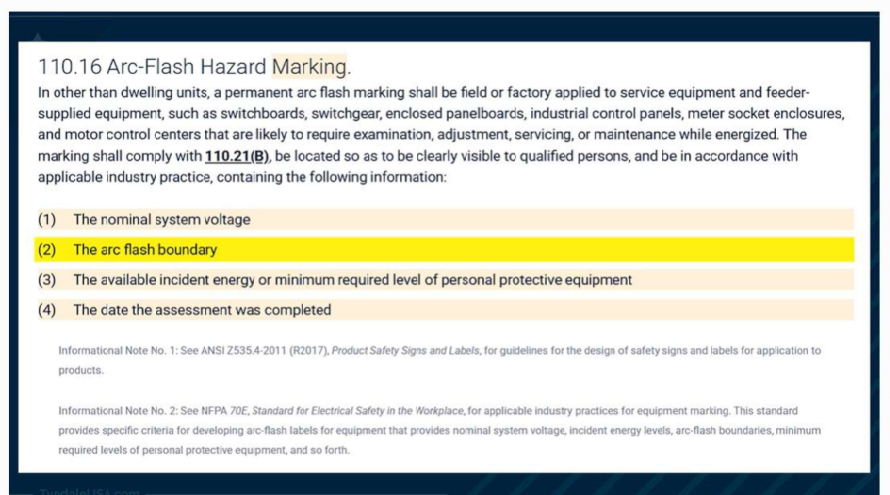


In General Industry - NFPA 70E is the Standard for Electrical Safety in the Workplace

The Priority of NFPA70E continues to be:
Is creating an “Electrical Safe Work Condition” (ESWC) to work de-energized and having an “arc flash risk assessment” **DONE!**



Labeling...





70E If Followed Will Prevent This...

TEST PARAMETERS

Voltage= **480**

Amperage= **15.8/ kA**

Cycles= **6**

Distance= **18"**

Incident Energy

4.1 cal/cm²



Clothing on mannequin:
Non-FR Henley and
Non-FR Jean

BULWARK.COM



The Solution....

TEST PARAMETERS

Voltage= **480**

Amperage= **16.6/ kA**

Cycles= **6**

Distance= **18"**

Incident Energy

4.5 cal/cm²



Clothing on mannequin:
iQ Series Men's Comfort Knit Long Sleeve
T-Shirt and Relaxed Fit Denim Jean

BULWARK.COM



Slowing it down...

TEST PARAMETERS

Voltage= **480**

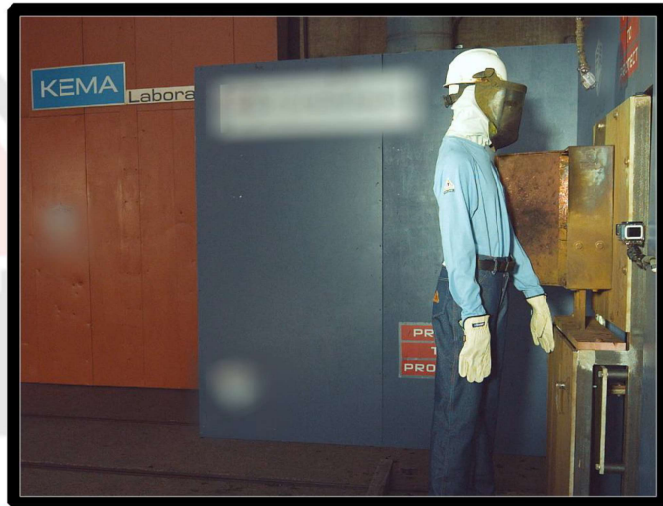
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Incident Energy

4.5 cal/cm²



Clothing on mannequin:
iQ Series Men's Comfort Knit Long Sleeve
T-Shirt and Relaxed Fit Denim Jean

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And tell an electrician this...





So how are you choosing your Arc Flash PPE ??

1. The incident energy analysis method or
2. The arc flash PPE category method

You must conduct an “arc flash risk assessment” to use either method

But there are important things to note....



Determining 70E 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 cal/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



Here we are after 25+ years of 70E...



SO...

Why are we still having arc flash injuries



Just a few that end up in my inbox....

5/24/2024 Brainerd, MN. High-voltage Technician Burned.. Fire Chief Tim Holmes said bystanders extinguished the fire and were caring for the severely burned Xavier Chevere when the Baxter Police Department arrived on scene. "The majority of his burns, from his chin down to about mid-thigh are third degree otherwise, he does have some second and third-degree burns on his knees, and then his face looks to be more first-degree,"

7/12/2024 Virginia Beach, VA. A man who was addressing electrical issues in the building suffered burn injuries to his head, neck and face, fire crews said. "It was pretty scary," said James Warren, a master electrician. "Real bright flash, sparks everywhere." After it happened, I ran down the ladder, ran down to the disconnect and shut power off to the building," Warren said.

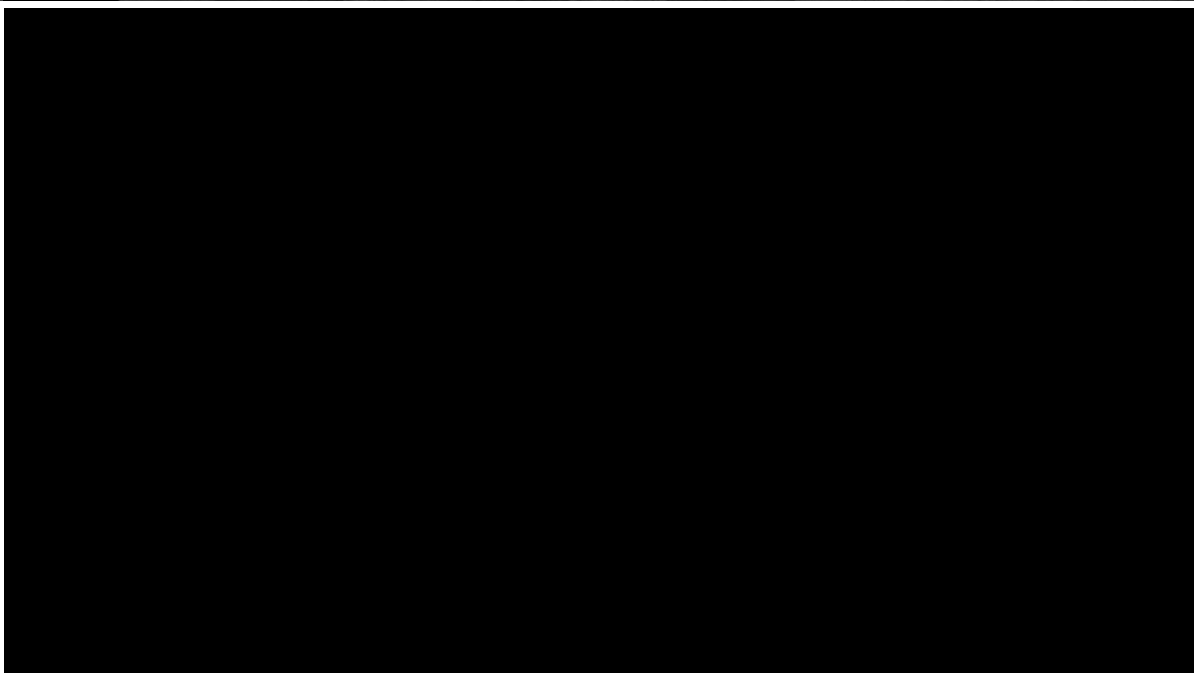
8/24/2024 Exton, PA "Shaun Keeney, was critically injured in a work accident. "The blast set his clothes and the building on fire and Shaun suffered severe second- and third degree burns to his head, face, neck, chest, arms, and hands," Keeney is expected to remain in the hospital for at least two months and will have to undergo multiple surgeries, skin grafts and extensive rehabilitation. Doctors have told him they expect his recovery to be over a year long.

10/24/2024 East Dundee, IL - A man was seriously injured Wednesday while installing electric vehicle charging stations at a northwest suburban auto dealership. "There was an arc [flash] inside of an electrical panel that they were working on to install some EV battery chargers at the dealership

10/26/2024 West Valley City, UT One person, who was on fire after the explosion, was transported to University of Utah Health's Burn Center in critical condition. "I keep thinking about seeing him rolling on the ground, screaming, his jacket literally ignited in flames just from the heat. You could see his skin falling off. He had gloves on that had kinda merged with his skin," Neilson recalled.



22-year-old man seriously injured in explosion





High-voltage Technician Burned – 5/24/2024

Brainerd Fire Chief Tim Holmes said bystanders extinguished the fire and were caring for the severely burned Xavier Chevere when the Baxter Police Department arrived on scene.

“The majority of his burns, from his chin down to about mid-thigh are third degree otherwise, he does have some second and third-degree burns on his knees, and then his face looks to be more first-degree,” Rosemary said. “They're actually letting that try and heal by itself. And his hair is actually growing back, which is kind of nice.”

<https://www.brainerddispatch.com/news/local/charging-station-burn-victim-faces-long-road-to-recovery>



Virginia Beach – Bahama Breeze 7/24





Working energized no PPE



WEST VALLEY CITY, Utah 10/26/2024





Worker recounts experience being injured in electrical explosion in West Valley - Utah - Oct 26, 2024, 11:26 AM

WEST VALLEY CITY, Utah — Dax Neilson is recovering after a shocking electric explosion Saturday morning in West Valley City.

Before 9:15 a.m. Neilson, a 21-year-old electrical apprentice, was out with four electricians working on a transformer outside of a building northeast of West Valley City.

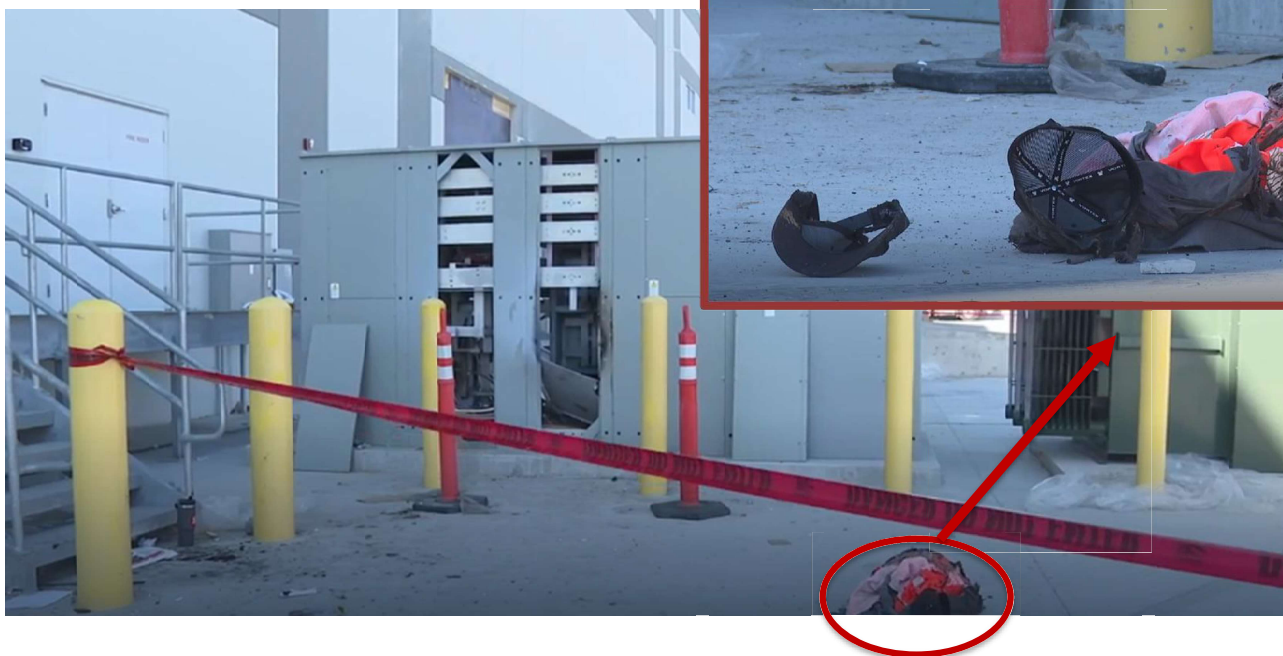
One person, who was on fire after the explosion, was transported to University of Utah Health's Burn Center in critical condition.

"I keep thinking about seeing him rolling on the ground, screaming, his jacket literally ignited in flames just from the heat. You could see his skin falling off. He had gloves on that had kinda merged with his skin," Neilson recalled.

The cause of the explosion is still under investigation, officials said.

"We were just sitting there, then out of nowhere — boom," Neilson said. "Day changed immediately."

<https://www.youtube.com/watch?v=DAG4JDEjguQ>





So, from 5/24 to 10/24, 5 separate incidents

What did they have in common?

What do you think?

No Arc rated PPE... Why???

1. Not Issued PPE
2. Issued PPE– not wearing it properly
3. Issued PPE – not wearing it at all
4. Thought equipment was deenergized – so not wearing PPE



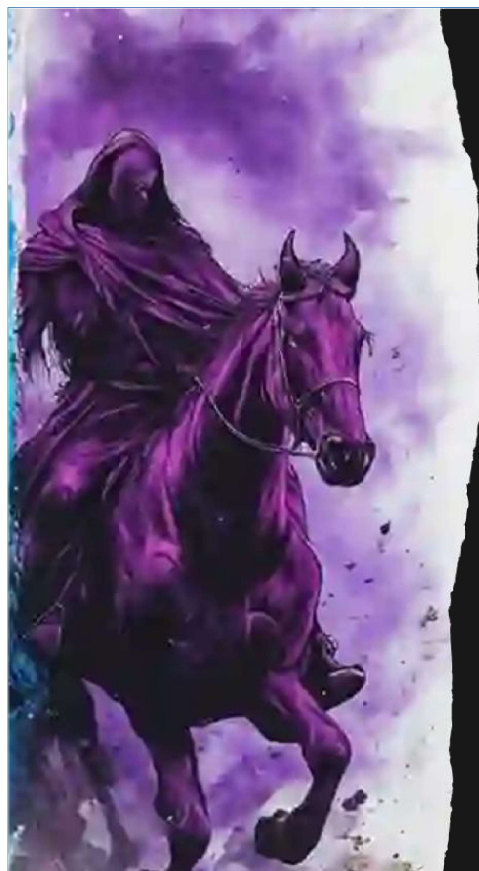
“So, where does your program break first?”

Show of Hands...

1. Not Issued PPE
2. Issued PPE– not wearing it properly
3. Issued PPE – not wearing it at all
4. Thought equipment was deenergized – so not wearing PPE



**We will call them –
Irresponsibility, Defiance, Negligence, and Complacency.**



Irresponsibility - what the worker says (the excuse)

“I don’t have it.”

“Nobody issued it.”

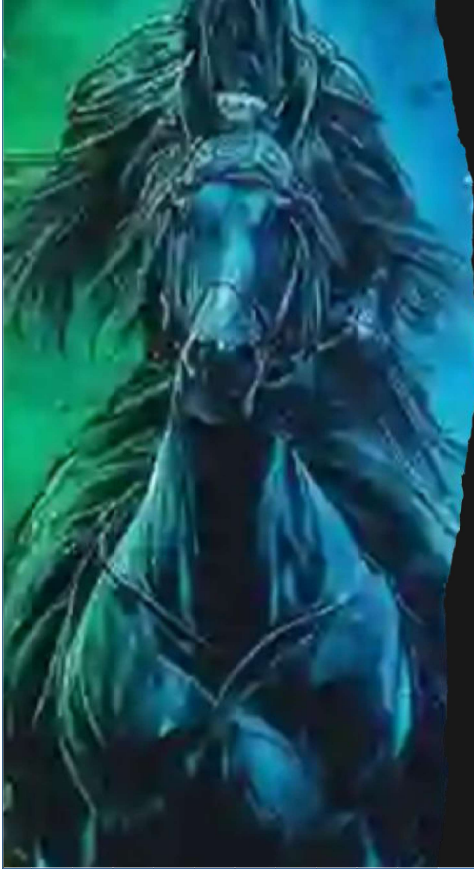
“We don’t carry that for this task.”

Trainers Response:

“If the hazard exists, PPE must exist before the work starts.”

“No PPE, no work. Stop and escalate.”

“Your job is to recognize the exposure and refuse the ‘wing it’ culture.”



Defiance - what the worker says (the excuse)

"It's just a quick check."

"It's too hot/cold, too bulky, doesn't fit right."

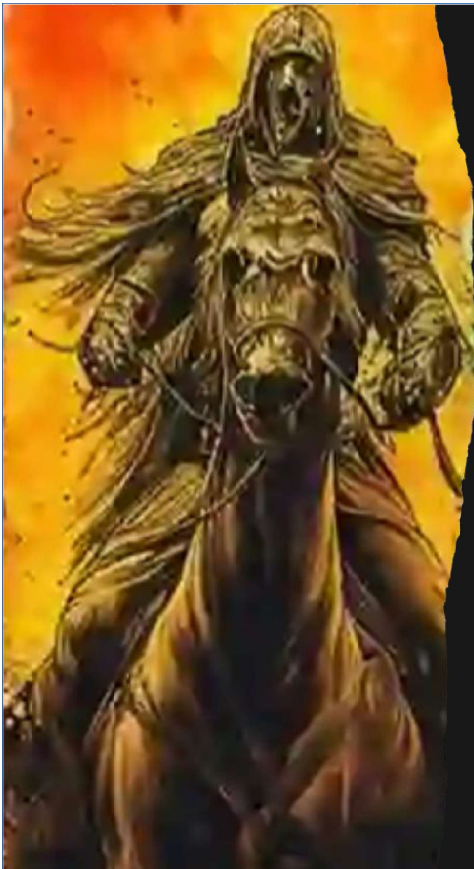
"I've done this a thousand times. It won't happen to me."

Trainer Response":

"The most dangerous words in electrical work are 'just real quick.'"

"Routine tasks create the highest temptation to skip PPE. That's exactly when you need the baseline."

"You don't get to bet your skin against probability. Wear the system, then do the task."



Negligence - what the worker says (the excuse)

"I've got FR on, I'm good."

"It doesn't matter if it's unzipped or untucked."

"This vest/rain gear is 'FR' so it's fine."

What trainers must teach (the correction)

"PPE works as worn, not as purchased."

"Open cuffs, open fronts, untucked shirts, rolled sleeves create exposure points and failure pathways."

"If it can be exposed, it must be appropriate for the hazard. 'FR' on a label is not automatically arc-rated."



Complacency - what the worker says (the excuse)“

“It was supposed to be de-energized.”

“LOTO was done. We’re good.”

“ we haven’t had one of those here in Years”

“That only happens to other crews.”

“We are trained on the old stuff this is the same”.

What trainers must teach (the correction)

“Assumptions kill. Verification protects.”

“De-energized is a condition you prove, not a feeling you have.”

“Your baseline protects you when the plan fails and the job changes.”



Diagnose your last near miss

- Pick one Horseman raise of hands



Overcoming the Four Horsemen

Takeaways:

- ✓ Equip teams with the right PPE and ensure its availability.
- ✓ Daily wear removes “choice”.
- ✓ Educate workers on proper wear and “Why”



What is the biggest barrier to “Daily” wear?

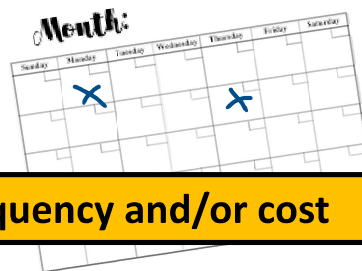
1. A task-based program is often used when workers are **not** frequently

So, the challenge... is frequency and/or cost

Determining Frequency, what's the magic number of tasks?

2. **What is the actual cost vs perceived cost?**

is typically a safer and more efficient way of protecting workers.





Exposure of a “task” based program

Let’s run the numbers:

You employ 10 electricians and each electrician completes an average of 10 energized tasks a day (Voltage testing, trouble shooting and verifying), 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.



Cost of the actual programs

Daily-Wear FR/AR Clothing Program

Initial Investment: \$1,000/employee for 5 sets of CAT2 FR clothing x 10 employees =

\$10,000.

Annual Maintenance:

\$500/year/employee for upgrades/replacements = **\$5,000/year.**

Total 5-Year Cost: \$30,000.

Task-Based FR/AR Coverall Program

Initial Investment: \$150 per coverall x 10 employees = **\$1,500** (good for 5 years).

Hidden Costs in Time:

- 10 stoppages/day to change in/out of coveralls.
- 10 minutes total (5 min to put on + 5 min to remove).
- 1,000 minutes/day x 30 days = **30,000 minutes/month** (500+ hours).
- 10 employees x \$40/hour = **\$20,000/month or \$240,000/year.**

5-Year Total Cost in Lost Productivity:

\$1,200,000.



Providing Peace-of-mind or Margin of Error (MOE)

Daily-wear is a baseline level of protection (MOE) 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.

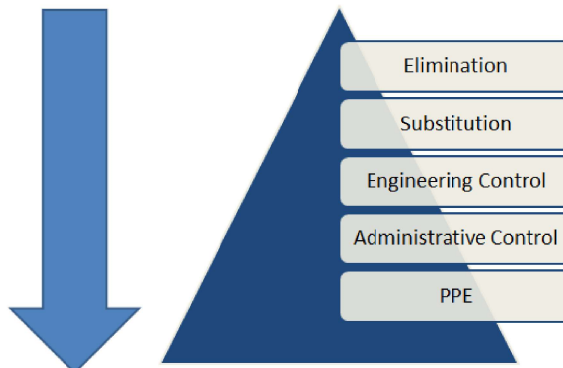


Hierarchy of Controls



What Flame Resistant Clothing is Not!

EFFECTIVENESS

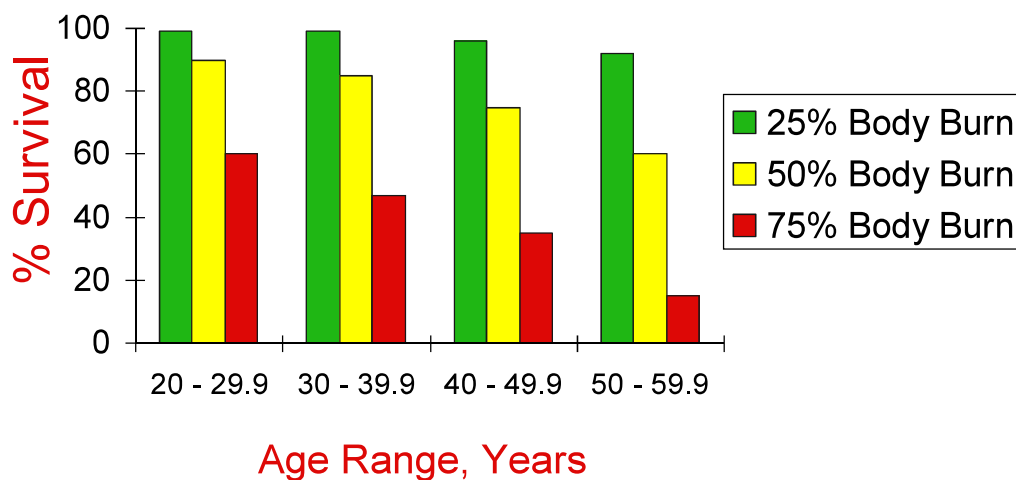




The Good news is if you wear it.... It works!!



Burn Injury – Chances of Survival



American Burn Association 2000 - 2009



PPE is your last line of defense...



But in an arc flash it is your only control & it doesn't work unless you are wearing it and wearing it correctly



FR/AR Use & Training

TRAINING – 1910.132(F)(1):

The employer shall provide training to each employee who is required by this section to use PPE. Each such employee shall be trained to know at least the following:

1910.132(f)(1)(i) - When PPE is necessary;

1910.132(f)(1)(ii) - What PPE is necessary;

1910.132(f)(1)(iii) - **How to properly don, doff, adjust, and wear PPE;**

1910.132(f)(1)(iv) - The limitations of the PPE; and,

1910.132(f)(1)(v) - The proper care, maintenance, useful life and disposal of the PPE.

1910.132(f)(2) - **Each affected employee shall demonstrate an understanding of the training specified in paragraph (f)(1) of this section, and the ability to use PPE properly, before being allowed to perform work requiring the use of PPE.**



FR/AR Baselayers Eliminate Problems:

In an Arc Flash the threat of break open is real

AR garment reaches its performance threshold and begins to fail exposing either the naked skin or the lightweight Non-AR undershirt to thermal energy causing injury or worse potential ignition adding to the injury.

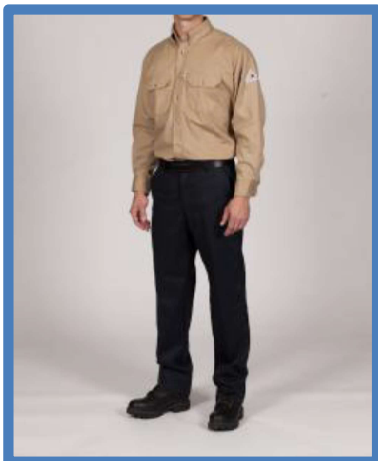
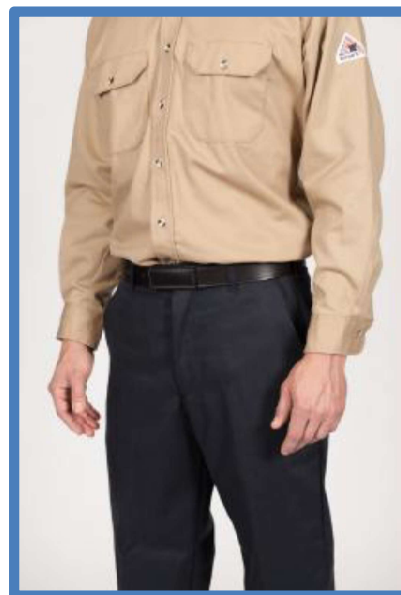
The need to police underwear

FR/AR Base layers buy into the overall goal of your AR Clothing program which is to minimize injury.



FR/AR Use & Training

FR Do's





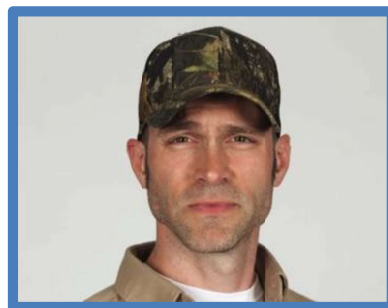
FR/AR Use & Training

FR Don'ts



FR/AR Use & Training

What could be wrong here???





CARE & MAINTENANCE: Protecting my Investment

Proper care and maintenance of FR/AR is essential to its effectiveness. While most industry standards recommend following the instructions provided by compliant garment manufacturers, some standards offer specific guidance and there are a few basic rules that apply across all relevant standards.



ASTM F1506 APPENDIX XI.3⁺⁺⁺⁺

XI.3.1 The garment manufacturer in conjunction with the fiber and fabric supplier should provide instructions for the care and maintenance of protective wearing apparel. See Guide ASTM F2757, Standard Guide for Home Laundering Care and Maintenance of Flame, Thermal and Arc Resistant Clothing or See Guide ASTM F1449 Standard Guide for Industrial Laundering of Flame, Thermal and Arc Resistant Clothing concerning care and maintenance.

ASTM 2757 – Home Laundering
ASTM 1449 Industrial Laundering

NFPA® 2113 GUIDELINES[†]

6.1.1* Flame-resistant garments shall be kept clean.

6.1.2* New flame-resistant garments shall be washed or dry-cleaned at least once prior to their initial use.

6.1.3* Flame-resistant garments shall be cleaned in accordance with manufacturer instructions, or if cleaning instructions are not provided, in accordance with the recommendations provided in ASTM F2757-09, Standard Guide for Home Laundering Care and Maintenance of Flame, Thermal and Arc Resistant Clothing, or ASTM F1449, Standard Guide for Industrial Laundering of Flame, Thermal, and Arc Resistant Clothing.

6.1.4 Flame-resistant garments shall be laundered or dry-cleaned with such frequency so as to prevent buildup of contaminants that reduce flame resistance.

Washed at least once prior to initial use

NFPA 70E® GUIDELINES[†]

(13) Care and Maintenance of Arc-Rated Clothing and Arc-Rated Arc Flash Suits.

(a) Inspection. Arc-rated apparel shall be inspected before each use. Work clothing or arc flash suits that are contaminated or damaged to the extent that their protective qualities are impaired shall not be used. Protective items that become contaminated with grease, oil, or flammable liquids or combustible materials shall not be used.

(b) Manufacturer's Instructions. The garment manufacturer's instructions for care and maintenance of arc-rated apparel shall be followed.

Laundered or dry cleaned with frequency so as to prevent build up of contaminants



- Important to read the manufacturer's laundry instructions on the label
- Written care instructions are available for all employees
- They can also be accessed at:
<http://www.Bulwark.com/Safety-Care>

CLD4RB3
L-RG
Excel FR
COMFORTOUCH
FLAME RESISTANT/
RESISTENTE A LLAMA/
RESISTANT AUX FLAMMES
ARC RATING
CALIFICACION DE ARCO/
EVALUATION DE L'ARC
9.1 ATPV
MADE IN MEXICO
HECHO EN MEXICO
FABRIQUE AU MEXIQUE
88% COTTON/ALGODON/
12% NYLON/nylon
NYLON
RN15220 CA22753
MACHINE WASH IN SOFT
WATER AT TEMPERATURE
NOT TO EXCEED 160°F
(71°C). TUMBLE DRY
NO BLEACH NO STARCH
OR FABRIC SOFTENER
NO PRODUCTS
CONTAINING HYDROGEN
PEROXIDE. FAILURE TO
LAUNDER PROPERLY
COULD AFFECT THE
FLAME RESISTANCE
FOR LATEST CARE INFO
WWW.BULWARK.COM



LAUNDRY TIPS – best practices

Although there are no special processes or equipment needed for cleaning FR/AR clothing, there are a few basic laundry guidelines:

1. Do not use any kind of bleach or peroxide
2. Do not use any additive that could build up and impede FR performance
3. Wash FR/AR garments separately
4. Turn FR/AR garments inside out to help color retention and preserve appearance
5. Use liquid detergent for best results
6. Avoid the hottest temperature to reduce the impact of shrinkage
7. For tough stains, soak garments in liquid detergent or non-bleach, non-peroxide pre-wash stain removers
8. For even tougher stains, Bulwark® FR/AR garments may be dry cleaned
9. Tumble dry on low setting and do not over dry
10. Rewash garments with lingering odor





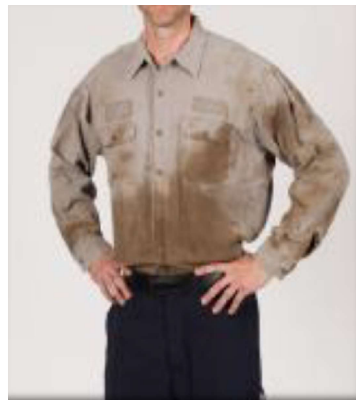
What Can You Use?



FR/AR Care & Maintenance

Soiled Garments:

- Monitor the accumulation of secondary accelerants on your garments through out the day.
- After laundering make sure accelerants are removed. If your garments still have a hydrocarbon/petroleum odor, a flammable contaminant may still be present. Rewash the garment until the odor is gone. If combustible soils are not completely removed, the protective qualities of the garment may be compromised.



**Discoloration/stains alone are not an indicator of reduced protection.*



Repairing or Replacing

Beyond proper cleaning, the efficient and safe care and maintenance of FR depends on regular and thorough inspection along with appropriate repair and/or replacement.

Regular inspections should look for:

- Correct fit - shrinkage can cause a garment to fit too tightly
- Garment integrity - this means tears, rips, loose seams, holes, etc.
- Stains - particularly the oily, sticky, or smelly ones

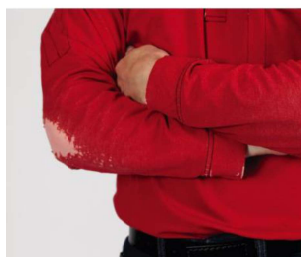
Repairs must be made with fabric and findings that match the protection level of the original garment.

Garments that cannot be safely repaired must be removed from service.

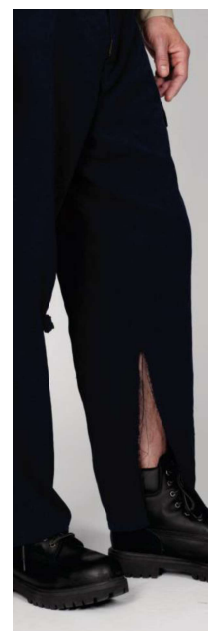


Repairing or Replacing

Garments that cannot



from service.





When Should a Garment be Retired?

- Garments are ill-fitting
- Closures no longer engage
- Aesthetically unpleasing
 - Threadbare
 - Worn/Abraded
 - Excessively ripped or torn
 - Heavily soiled or stained



Bottom-line.....

Wear it correctly; zipped, buttoned and tucked!





Bonus....

SOME STANDARDS ALONE ARE NOT ENOUGH; and SOME ARE JUST WRONG!!!

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

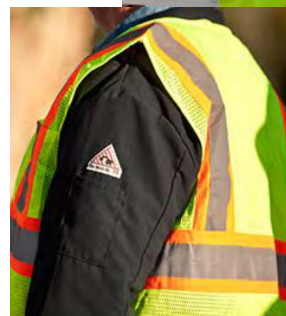
- ASTM F2302 – **STANDARD IS WITHDRAWN**
- ASTM D6413 – **NOT A PERFORMANCE STANDARD**
- NFPA 701 - **NOT A GARMENT STANDARD**

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



Things that should make you go, Hmmm...



HRC

Self
characteristic that they
state **wears out**

Garment is made from 100% Polyester Treated
to be Self-Extinguishing as defined by ASTM D6413
(<2.0 Second Flameout / $<6''$ Char Length)

ASTM 6413 is **not**
a performance standard,

ASTM 6413 can and does create a false POSITIVE when used exclusively on synthetic and rubber-based materials. Additional testing is needed to provide evidence that these garments will protect in your hazard

How can you say FR when on
the same label you say it is nonFR

Common Electrical Work Myths



**Occupational
Safety and Health
Administration**



For more information:
 **Occupational
Safety and Health
Administration**
www.osha.gov (800) 321-OSHA (6742)

ACTION SAVES LIVES

Summary

**BUY/GET GOOD STUFF, WEAR IT PROPERLY
AND TAKE CARE OF IT AND IT WILL TAKE
CARE OF YOU**

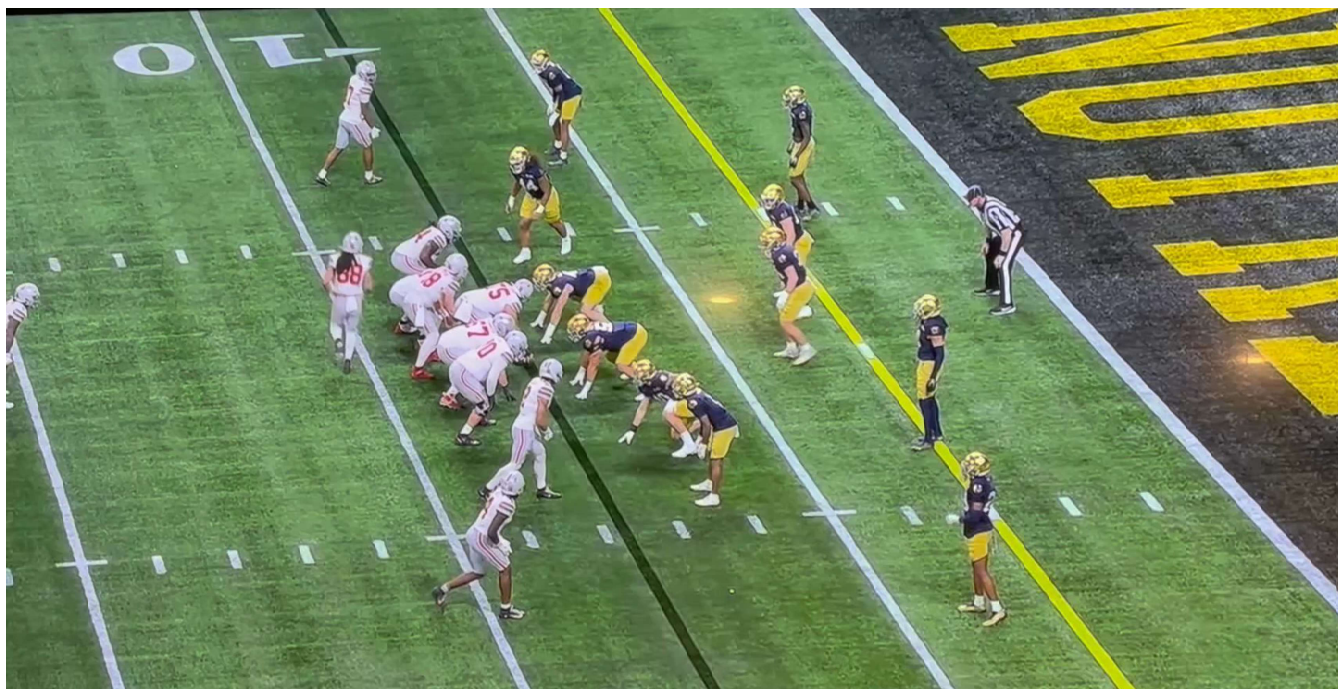


One last thing to think about....

STOP WORK!!!



What happens when you don't have it.....





THANK YOU

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#CRSCSafetyConference