ENERGY SAFETY CANADA

ENERGY SAFETY CONFERENCE

Demystifying Proper Selection, Use, Care & Maintenance of Flame-Resistant Clothing

Flame Resistant Clothing, the often-overlooked piece of protection

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 significant 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…

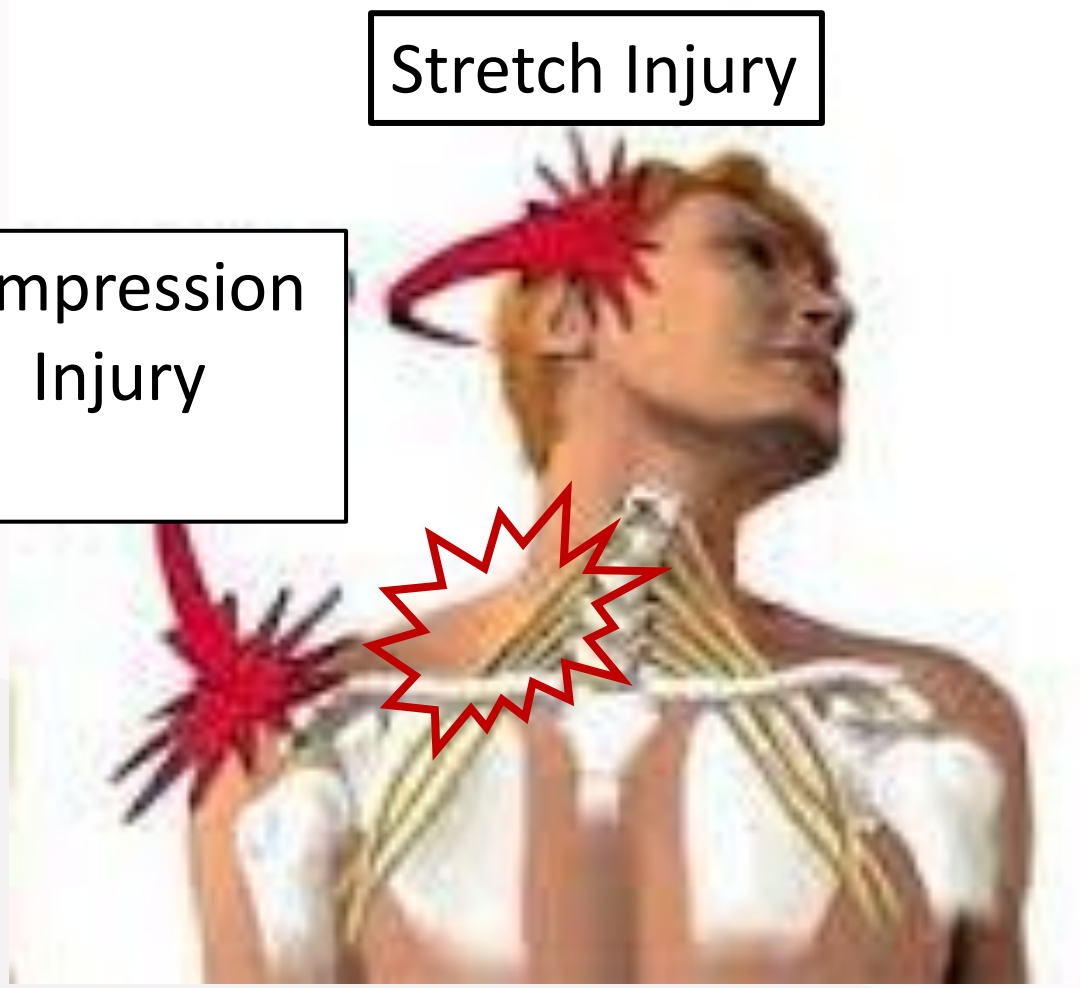
- 10 to 12 games per season, spring ball, two-a-days, and weekly practices—resulting in approximately 30,000 contacts or impacts.
- Within those, 10% or 3,000 are considered high risk. For an O-Lineman like myself, that means pulling at 4 mph and picking up a blitzing player closing in at an average of 6 miles per hour.
- Imagine 3,000 collisions at 10 miles an hour.

Hi Impact/Hi Risk -

My 0.01%

I suffered over 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), and ultimately the career ender—a Brachial Plexus Injury.

Brachial Plexus Injury



Is 99.99 good enough?

What will your 0.01% look like in 10 years?

You like me are trained, protected, & coached

Yet unlike me: You can stop, You can rethink, You can rework, You can reposition, You can question…

Where my injuries were reasonable and acceptable for my position, and what was expected of me – that is not true for you, not today.

My goal, my purpose of todays training is to contribute to improving on your 99.99%.

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).

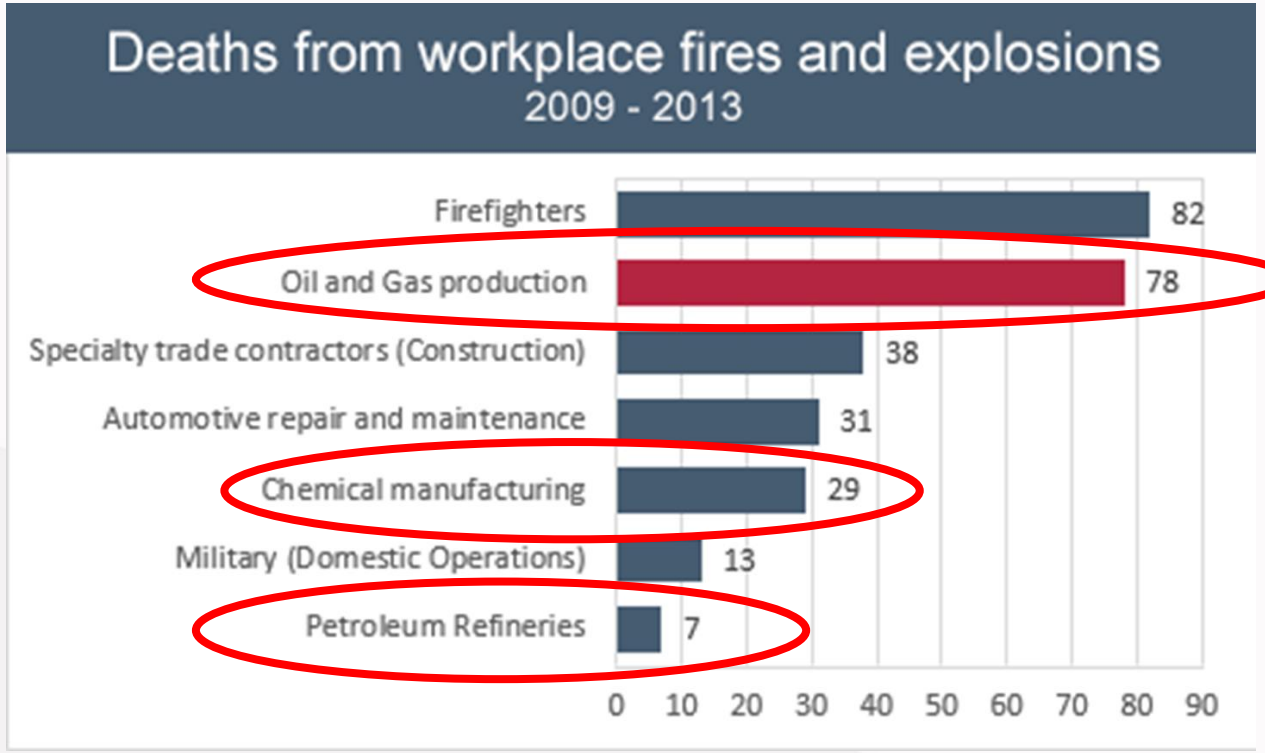
SOME BACKGROUND…

WESTEX TEEX 2010

BULWARK - UNR 2011

TYNDALE - TEEX 2022

Inherently dangerous…..



Why FR Clothing?

Injuries and Fatalities do Happen

Labor Statistics shows that over any 10-year period in Oil and Gas

- ~32,000 workers suffered lost-time work injuries because of an industrial fire or explosion.

Look at any 2-year period - between 50 and 200 fatalities from fires and explosions

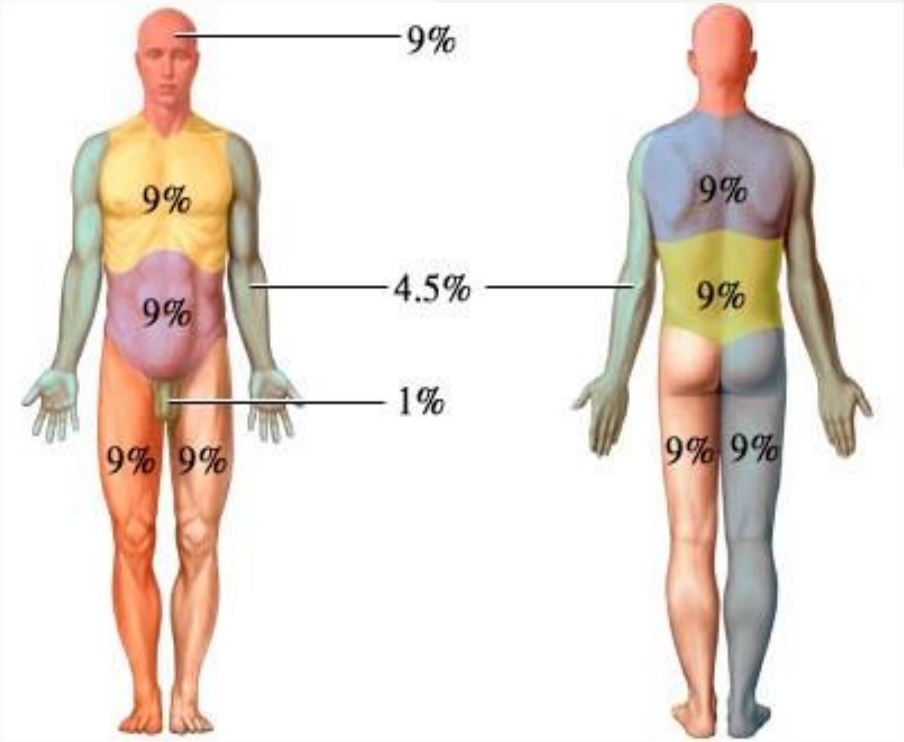
Reports show more than 5,000 on average are injured in fires and explosions on the job each year

Is the Hazard Flash Fire?

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

“FRC’s are too expensive!” ….compared to what?

- Burn treatment requires approx. 1.5 days hospitalization per % burn
- The average hospital stay for a survivor with 40-60 percent body burn is 54 days at costs exceeding $25,000/day
- Hospitalization cost typically range from **$200,000 to $750,000, with many over $1,000,000 USD**
- **Lifetime Costs can exceed $10,000,000.00 USD**



What do these slides tell us?

The potential cost but what they don't tell us…The personal cost, the Human side

Burns can take a psychological toll, patients also may face psychological stressors, such as:

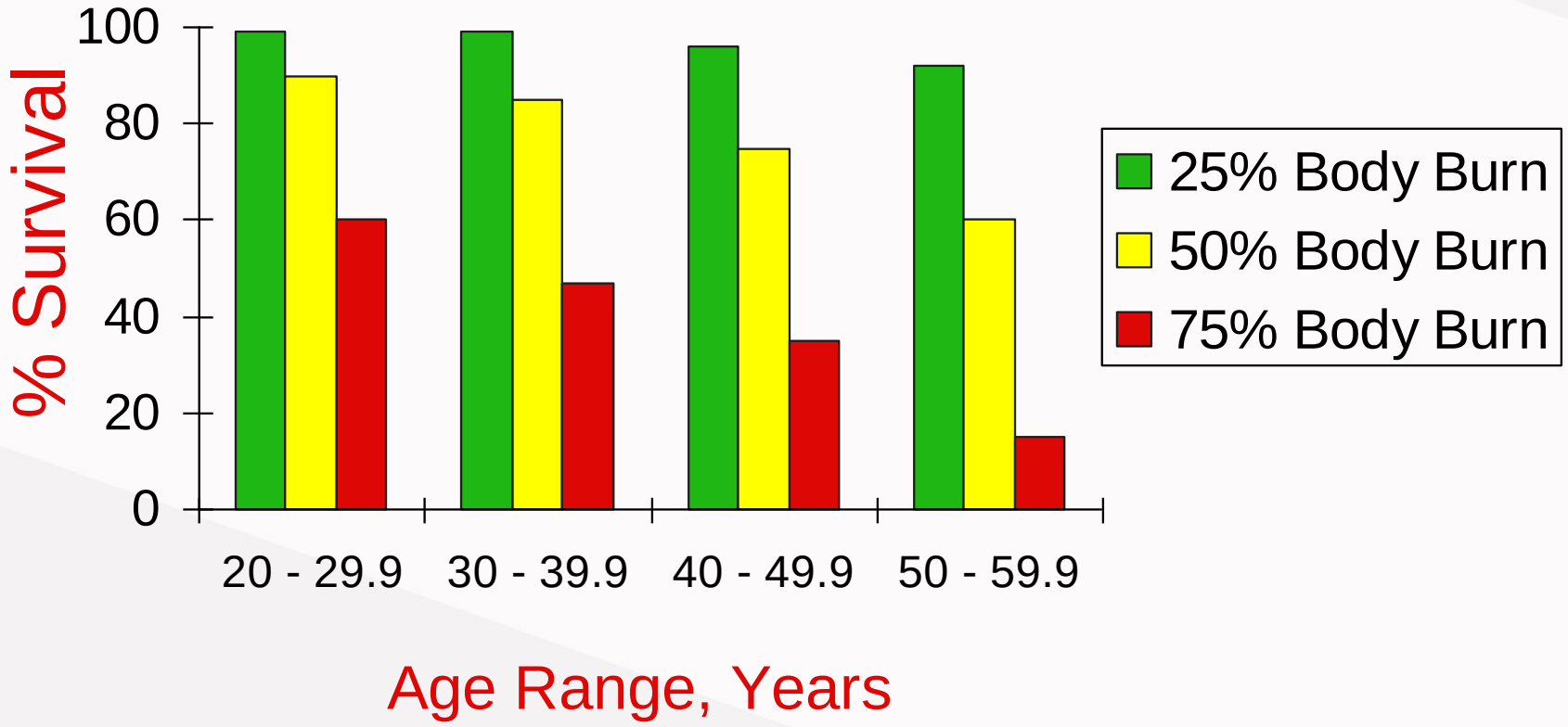
- Changes in body image
- Depression

And it is not just the survivor who is impacted; why, because they are an employee, a coworker, a friend, a son, a daughter, a brother, a sister, a father, a mother – it is ALL that they have touched and will touch.

- Difficulty sleeping or having nightmares
- Flashbacks of the accident
- Irritability
- Loss of interest in previously enjoyable activities
- Negative thoughts about oneself
- Social withdrawal

Why We Must Address the Psychological Impact of Burns; January 20, 2017, By Jeffrey Shupp, MD, Director, Burn Center

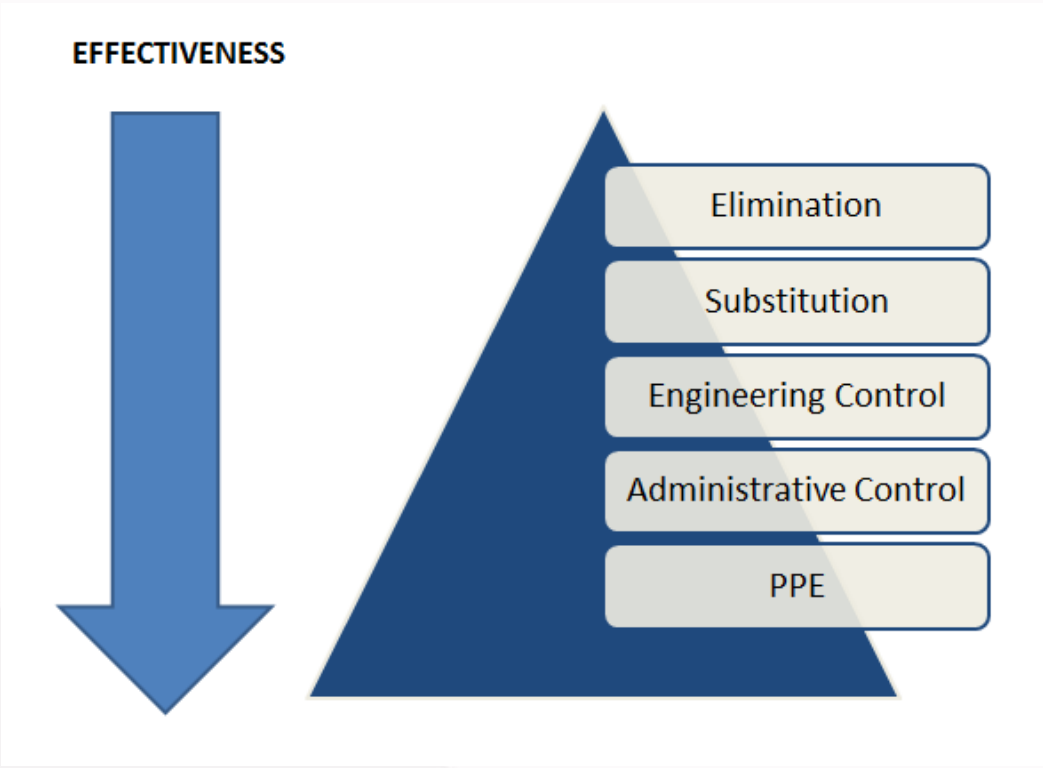
FRC's just don't work…



The Benefit of FR Clothing

Hierarchy of Controls

What Flame Resistant Clothing is Not!



Bulwark PROTECTION

PPE is Your Last Line of Defense…

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

CCOHS is the **“SHALL”**

Your **Standards** are the **“HOW”**

CCOHS.ca
Canadian Centre for Occupational Health and Safety

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

ASTM INTERNATIONAL
Standards Worldwide

ANSI
American National Standards Institute

NFPA®

CSA Group

Your Standards ….

Flash Fire Defined

Flash Fire - A Fire that spreads by means of a flame front rapidly through a diffuse fuel such as a dust, gas or vapors of an ignitable liquid, without the production of damaging pressure

The addition of the phrase "short-duration thermal exposure" This phrase was added because some feel NFPA 2112 should be for fabrics and garments to protect against various thermal exposures and not just a 3 second flash fire. Plus, there are thermal exposures other than just the initial flash fire that wearers could encounter during and after the initial event.

N 3.3.34* Short-Duration Thermal Exposure from Fire. A period of egress from or accidental exposure to thermal events, including but not limited to, vapor cloud fires, jet flames, liquid fires (pool fires or running liquid fires), solids fires (fires of solid materials or dust fires), or warehouse fires.

The difference between NFPA® 2112 and 2113

NFPA 2112 is the Standard on Flame-Resistant Garments for Protection of Industrial Personnel Against Short Duration Thermal Exposures From Fire. This standard outlines the various performance requirements and testing methods for both the FR fabric and FR garments that are needed to be considered in compliance with the standard

NFPA 2113 is “Standard on Selection, Care, Use and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel against Flash Fire.” NFPA 2113 provides greater detail on how to select proper FR garments. Chapter 4 speaks directly to Selection and gives guidance on Hazard Assessment, Selection of FR Garments and Purchase Specifications.

Although meeting the performance requirements of NFPA 2112 is important, NFPA 2113 is needed to determine what kind of FR you should consider.

NFPA 2112 Requirements

What it is….

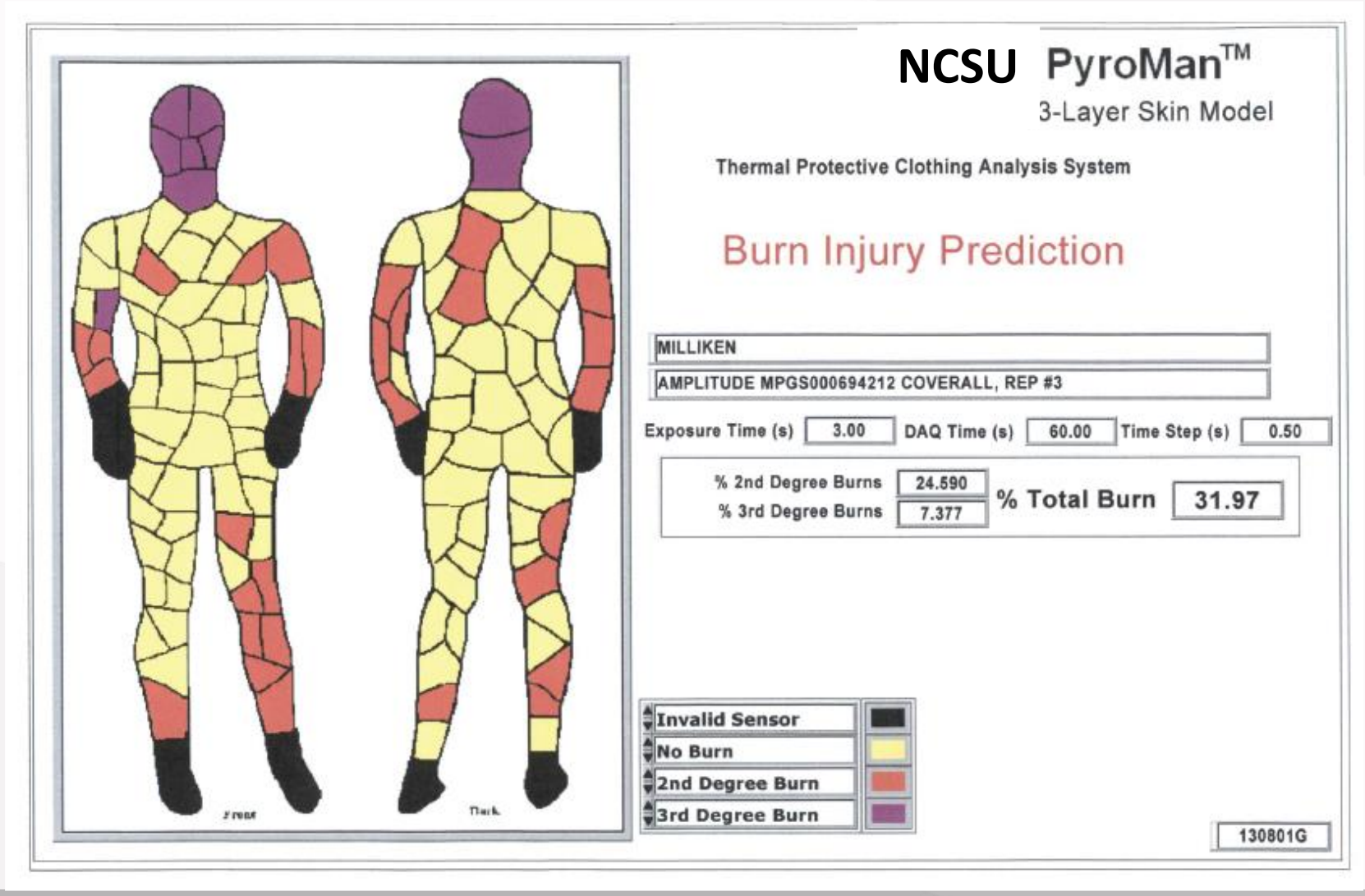
- A means of certifying fabrics & findings suitable for use in FR clothing to be worn as protection against possible flash fire exposure

Fabrics must :

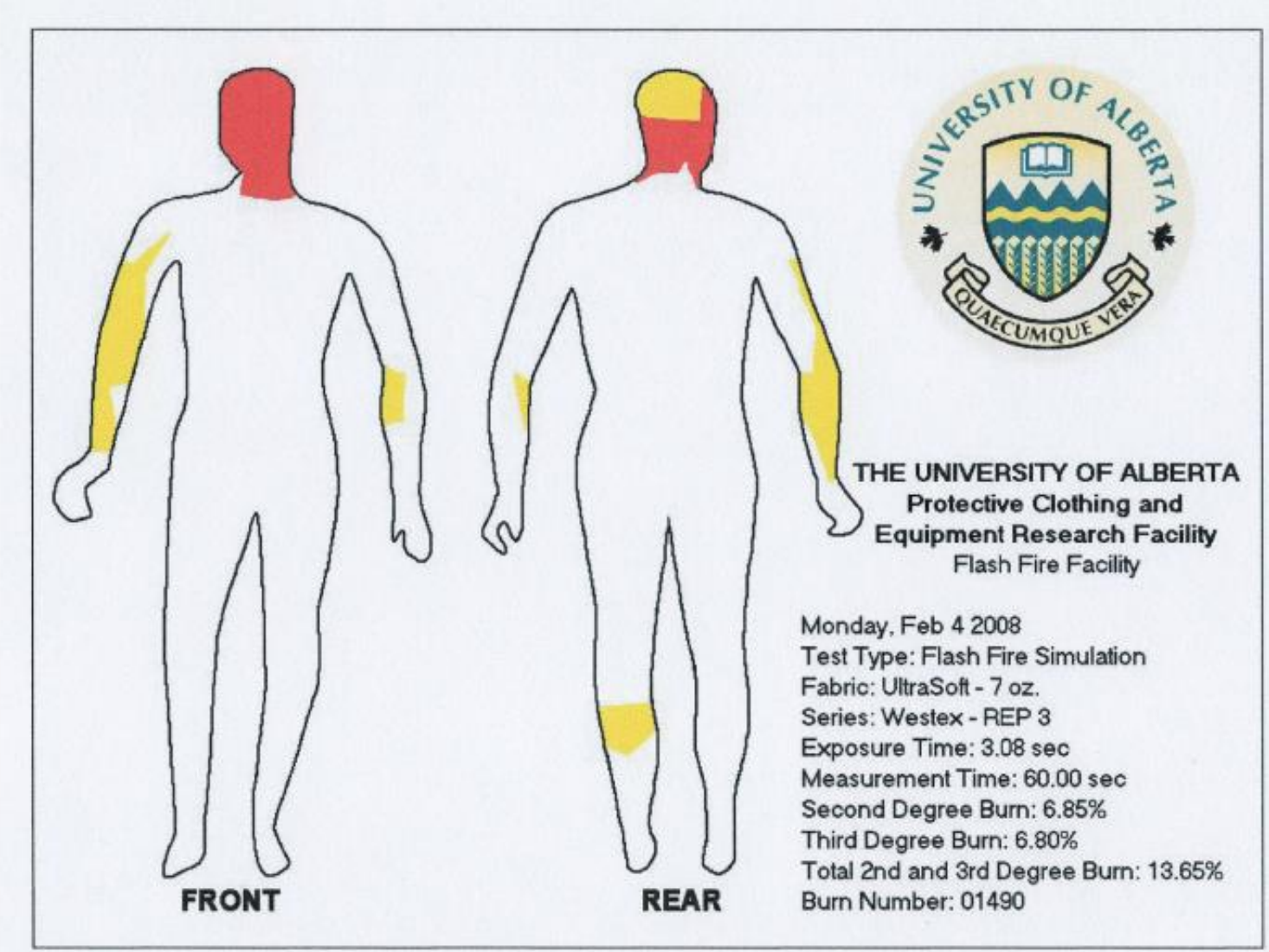
- Retain flame resistance through multiple launderings
- Meet standards for heat transfer performance, thermal stability and heat resistance
- Result in less than 50% predicted body burn when tested in on a thermal manikin over underwear in a flash fire of 3 seconds

Instrumented Manikin Test

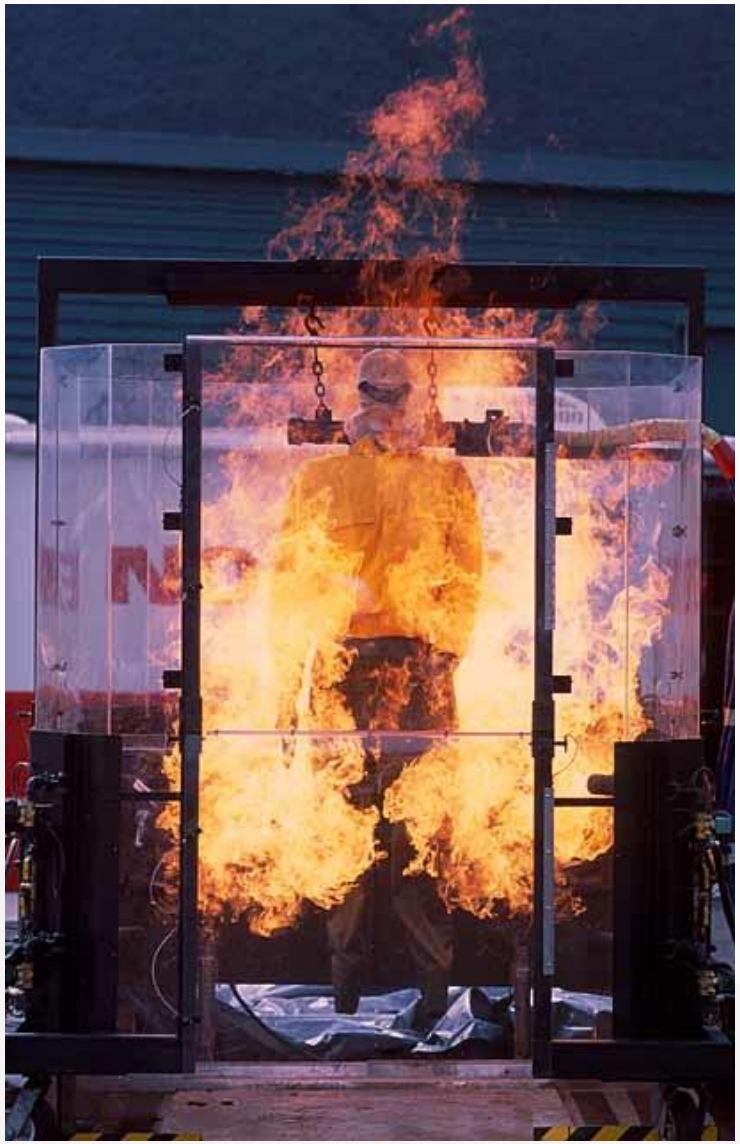
Instrumented Manikin Results



Instrumented Manikin Results



Be Cautious - Understanding ASTM F1930



NFPA 2112 requires
less than 50% predicted
body burn

Be Cautious - Understanding ASTM F1930

For illustrative purposes **ONLY** as we can't account for **ALL** variables lets look at a specific example which has the ignition source in front of the mannequin and the leak (source) behind and compare this to the laboratory environment.

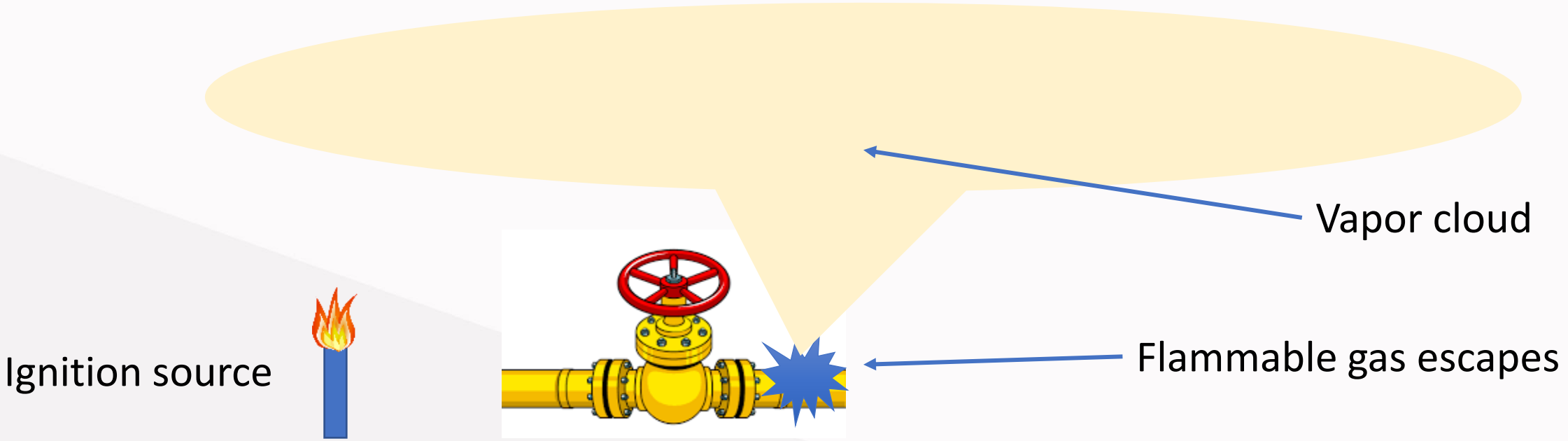
Let's take two different test results for BB

32% and 14%

Which one is better?

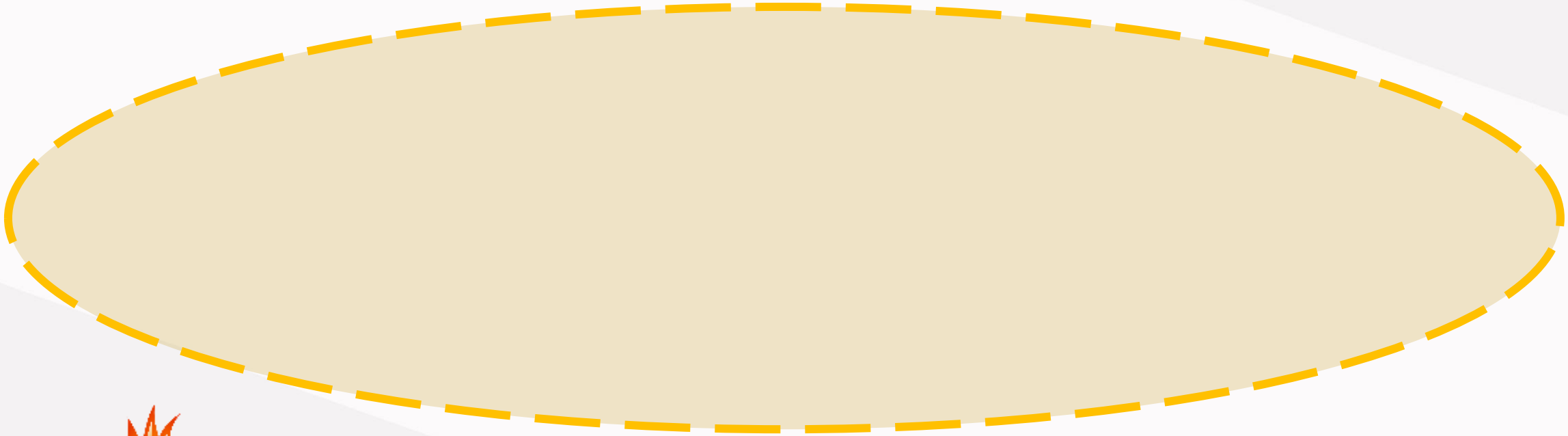
Flash Fire Dynamics

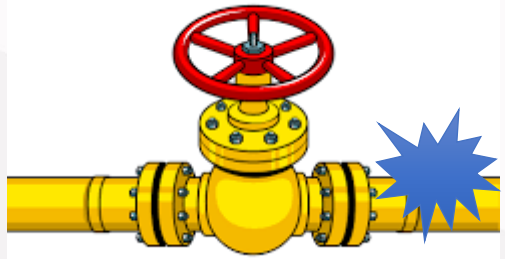
Flash fires consist of a fuel source with a separate ignition source.



Flash Fire Dynamics

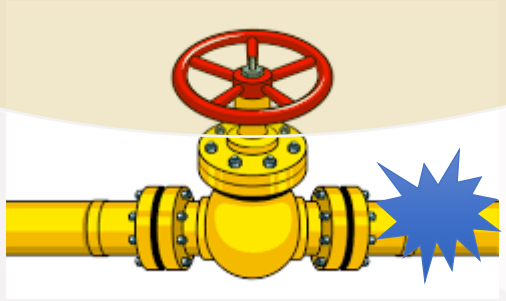
The vapor cloud of flammable gas continues to grow until it nears the ignition source where the activation energy is present.





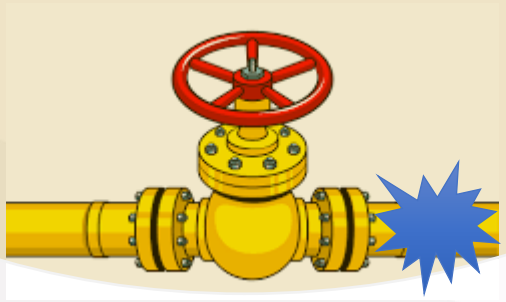
Flash Fire Dynamics

The flame front moves rapidly back towards the fuel source.



Flash Fire Dynamics

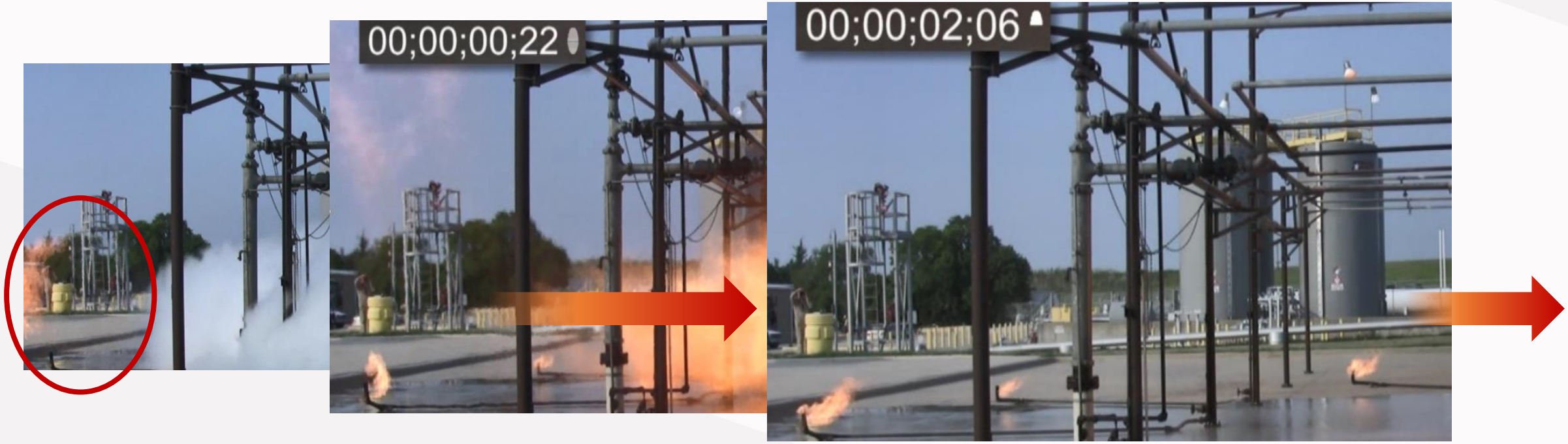
The flame front moves to consume all the fuel and circles back to the fuel source.



Flash Fire Dynamics

After the vapor cloud is consumed, the flash fire becomes a fuel-fed fire unless the fuel source is eliminated/cut off.

So how does it look in the real world?



Bulwark®
PROTECTION

Are **all** flame-resistant fabrics and garments Independently Certified to be NFPA 2112 compliant?

NO!

So where can it go wrong?

Poor construction can't be compliant

- 2112 compliant fabrics, poor construction

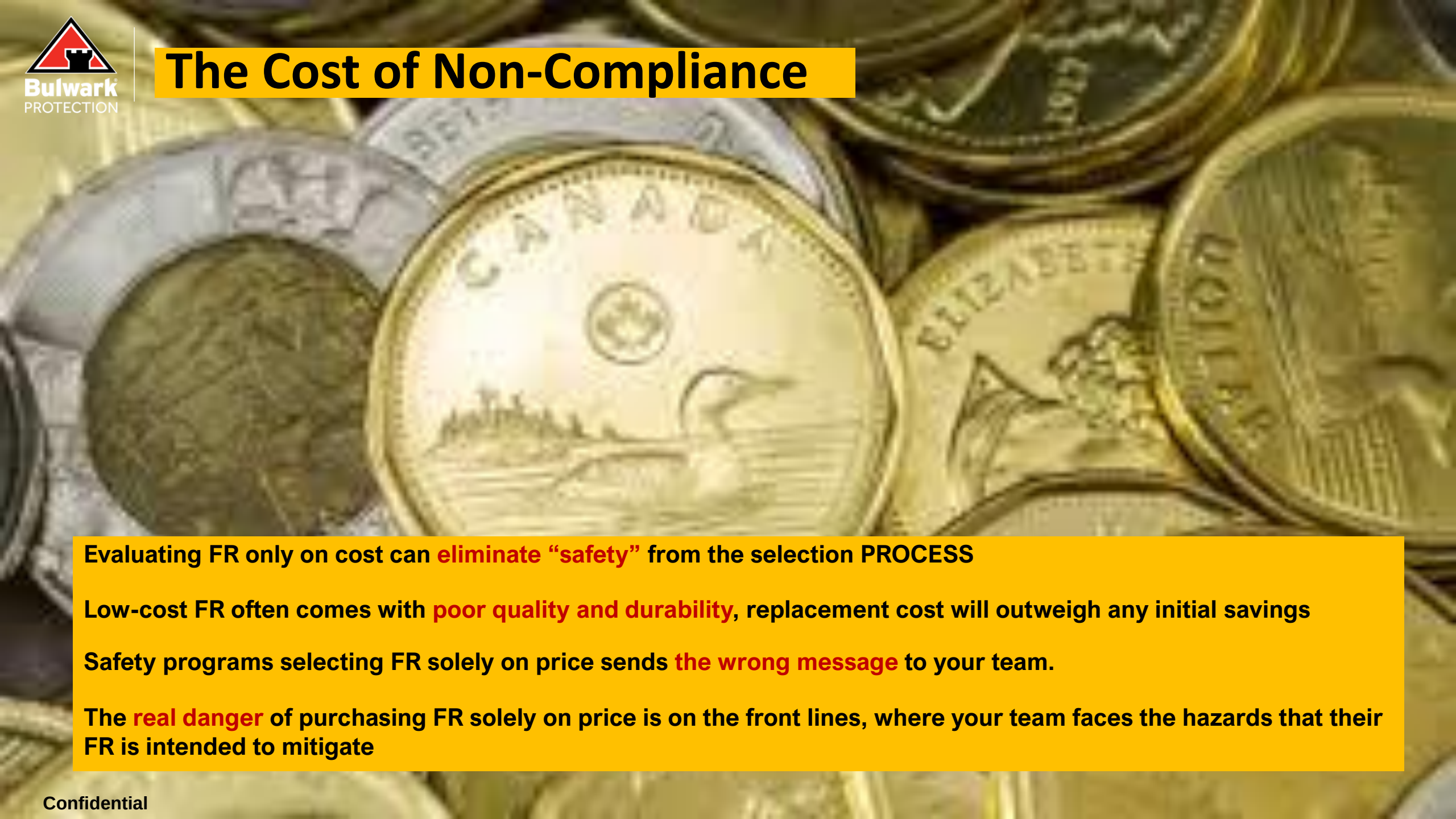
- 2112 compliant garment but not the retro-reflective tape.

- Noncompliant findings – like zippers (nonFR Tape, meltable teeth vs FR tape, 4-way panic zipper)

Non-Compliance = consequences ….

Inexpensive/cheap PPE may save you some dollars in the short run as it doesn't show up until you need it to protect your people!

The Cost of Non-Compliance



Evaluating FR only on cost can eliminate "safety" from the selection PROCESS

Low-cost FR often comes with poor quality and durability, replacement cost will outweigh any initial savings

Safety programs selecting FR solely on price sends the wrong message to your team.

The real danger of purchasing FR solely on price is on the front lines, where your team faces the hazards that their FR is intended to mitigate

Where can I look…NFPA 2112 Label Requirements

We are all too familiar with misleading claims but are you aware of misleading labels in FR garments? NFPA mandates strict labeling requirements and not everyone follows the rules. In addition to bearing the mark of the 3rd party certifier, these words and the edition of the standard must appear on the label of a certified garment:

"THIS FLAME-RESISTANT GARMENT MEETS THE REQUIREMENTS OF NFPA 2112-2012 STANDARD ON THE FLAME-RESISTANT GARMENTS FOR THE PROTECTION OF INDUSTRIAL PERSONNEL AGAINST FLASH FIRE”

Beware of subtle changes in wording on the label that claim to meet a portion of the standard. The following language does not meet the requirements of NFPA 2112:

"THIS GARMENT MEETS THE PERFORMANCE REQUIREMENTS OF NFPA 70E-2009, ASTM F1506-02ae1, NFPA 2112-2007.

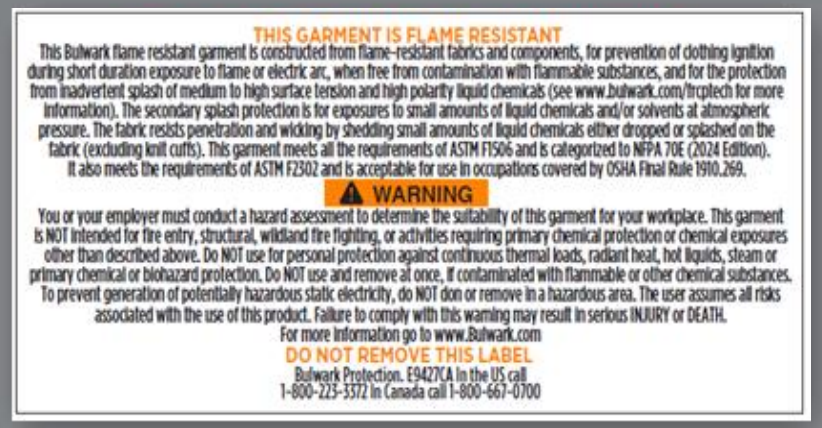
Required Labeling for NFPA 2112 Compliance

REQUIRED LABELING

These two examples correctly list and briefly describe the

….. but not everyone follows the rules.

and labeling requirements for the relevant standards and regulations, or they indicate that the garment has been certified by a third-party, in this case Underwriters Laboratories.


THIS GARMENT IS FLAME RESISTANT

This Bulwark flame resistant garment is constructed from flame-resistant fabrics and components, for prevention of clothing ignition during short duration exposure to flame or electric arc, when free from contamination with flammable substances, and for the protection from inadvertent splash of medium to high surface tension and high polarity liquid chemicals (see www.bulwark.com/frcpltech for more information). The secondary splash protection is for exposures to small amounts of liquid chemicals and/or solvents at atmospheric pressure. The fabric resists penetration and wicking by shedding small amounts of liquid chemicals either dropped or splashed on the fabric (excluding knit cuffs). This garment meets all the requirements of ASTM F1506 and is categorized to NFPA 70E (2024 Edition). It also meets the requirements of ASTM F2302 and is acceptable for use in occupations covered by OSHA Final Rule 1910.269.

⚠ WARNING

You or your employer must conduct a hazard assessment to determine the suitability of this garment for your workplace. This garment is NOT intended for fire entry, structural, wildland fire fighting, or activities requiring primary chemical protection or chemical exposures other than described above. Do NOT use for personal protection against continuous thermal loads, radiant heat, hot liquids, steam or primary chemical or biohazard protection. Do NOT use and remove at once, if contaminated with flammable or other chemical substances. To prevent generation of potentially hazardous static electricity, do NOT don or remove in a hazardous area. The user assumes all risks associated with the use of this product. Failure to comply with this warning may result in serious INJURY or DEATH.

For more information go to www.Bulwark.com

DO NOT REMOVE THIS LABEL

Bulwark Protection. E9427CA In the US call 1-800-223-3572 In Canada call 1-800-667-0700

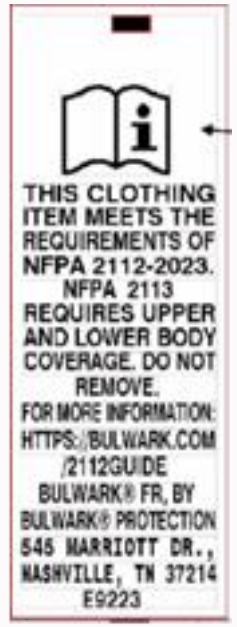

THIS GARMENT MEETS THE REQUIREMENTS OF NFPA 2112, STANDARD ON FLAME-RESISTANT GARMENTS FOR PROTECTION OF INDUSTRIAL PERSONNEL AGAINST FLASH FIRE, 2012 EDITION.NFPA 2113 REQUIRES UPPER AND LOWER BODY COVERAGE. PROTECTIVE CLOTHING FOR PROTECTION OF INDUSTRIAL PERSONNEL AGAINST FLASH FIRE IN ACCORDANCE WITH NFPA 2112-2012

DO NOT REMOVE 15UR E9297CA

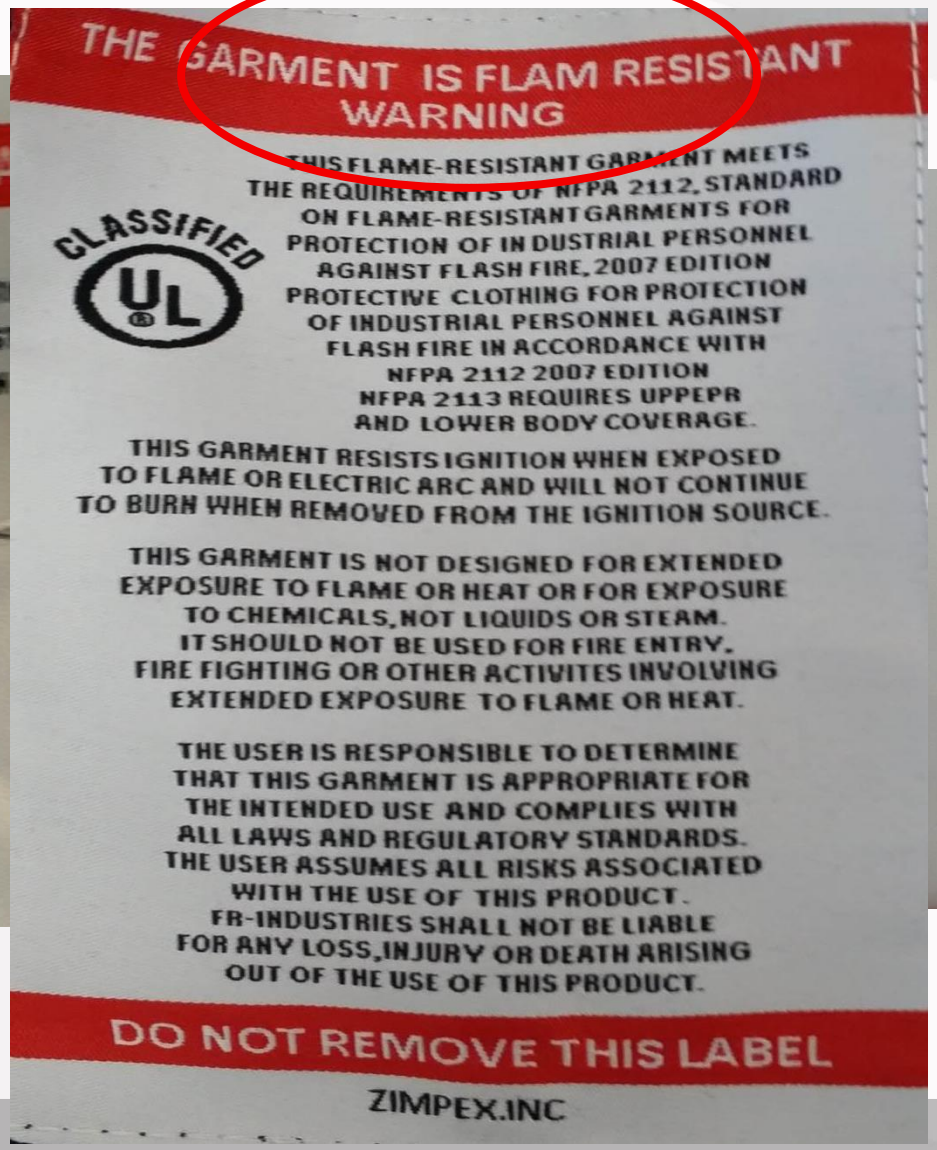
ALPHA SIZES	XS	S	M	L	XL	2XL
CHEST	34	36-38	40-42	44-46	48-50	52-54

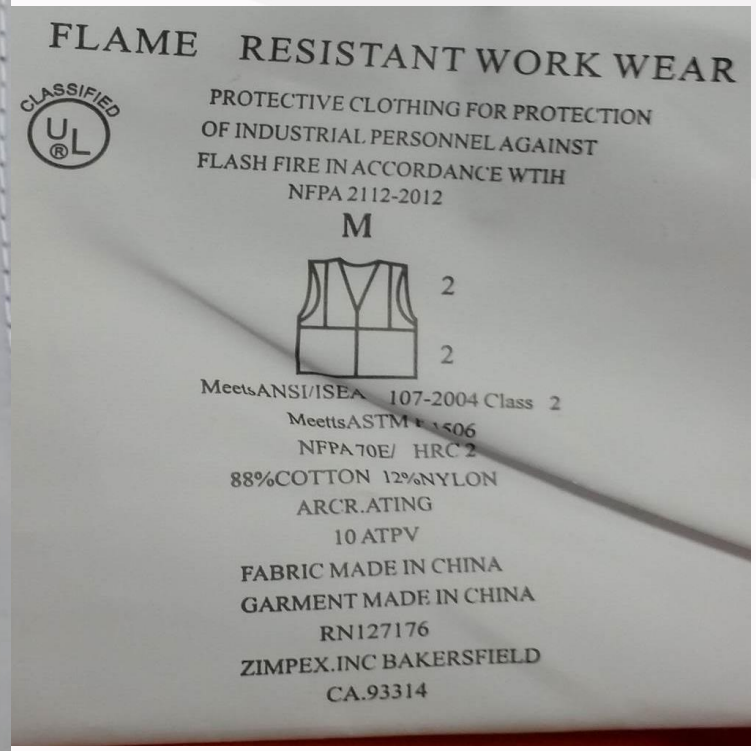
SHORT=27" INSEAM REGULAR=30" INSEAM LONG-32" INSEAM

Bulwark Protective Apparel, a brand of VF Imagewear Inc.
545 Marriott Drive, Nashville TN 37214



Anyone can make a label…





NFPA 2113 - Your Playbook

Standard on Selection, Care, Use and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Short Duration Thermal Exposure from Fire

Provides guidelines for:

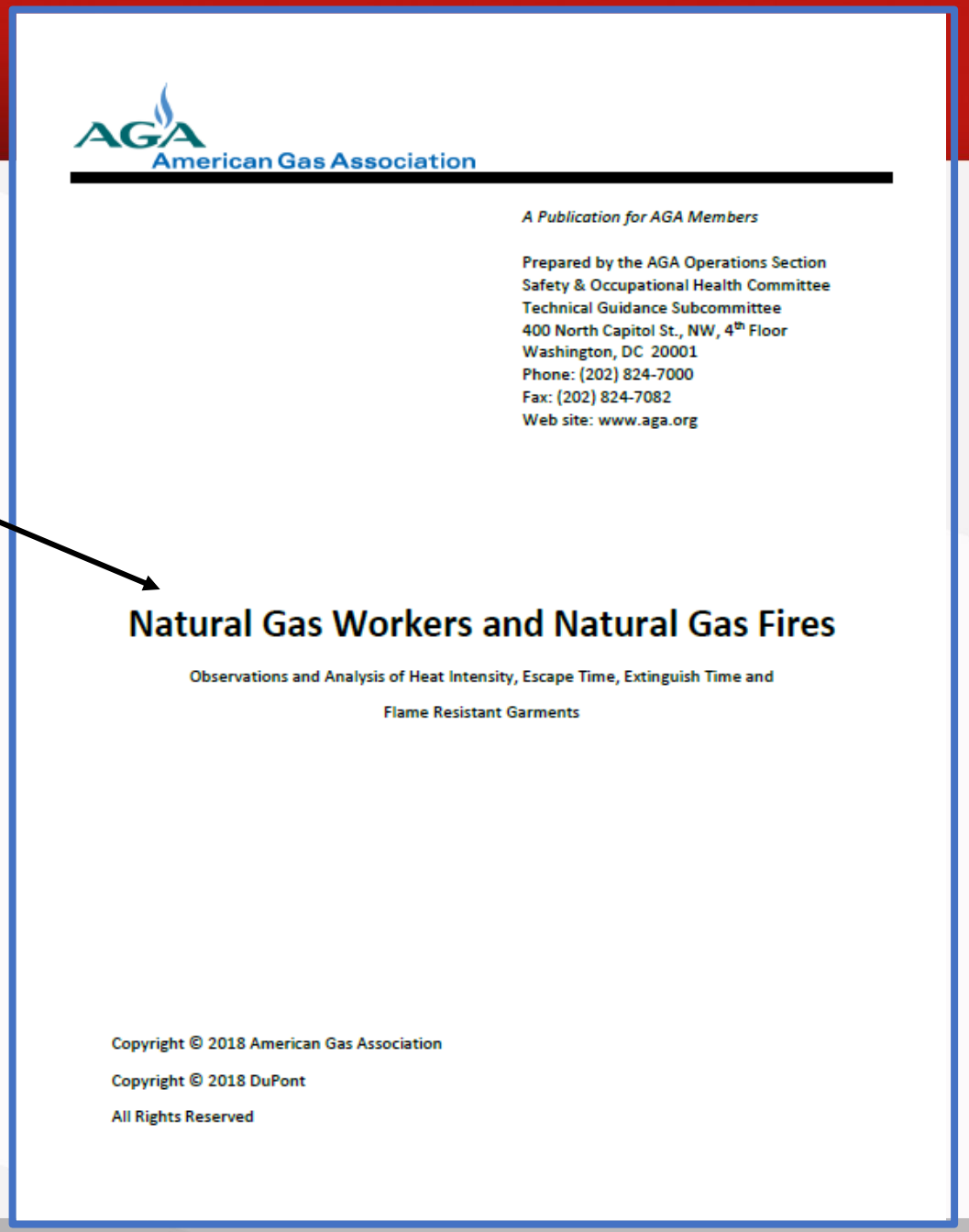
1. Conducting a hazard assessment
2. Selecting FR garments (specifications)
3. Properly using FR garments (Training)
   - Upper & lower body coverage
   - Collars, sleeves, cuffs
   - Layering
4. Care and Maintenance
   - Emblems and embroidery
   - Cleaning

What if we need more?

Natural Gas Workers and Natural Gas Fires

Observations and Analysis of Heat Intensity, Escape Time, Extinguish Time and Flame-Resistant Garments

Prepared by Michael R. Anderson, National Fuel Gas Company Brian E. Foy, DuPont Company Christopher W. Newton, DuPont Company AGA Staff Kimberly Denbow, Security, Operations and Engineering Services Director Juanita Spence, Operations and Engineering Specialist



AGA American Gas Association

A Publication for AGA Members

Prepared by the AGA Operations Section
Safety & Occupational Health Committee
Technical Guidance Subcommittee
400 North Capitol St., NW, 4th Floor
Washington, DC 20001
Phone: (202) 824-7000
Fax: (202) 824-7082
Web site: www.aga.org

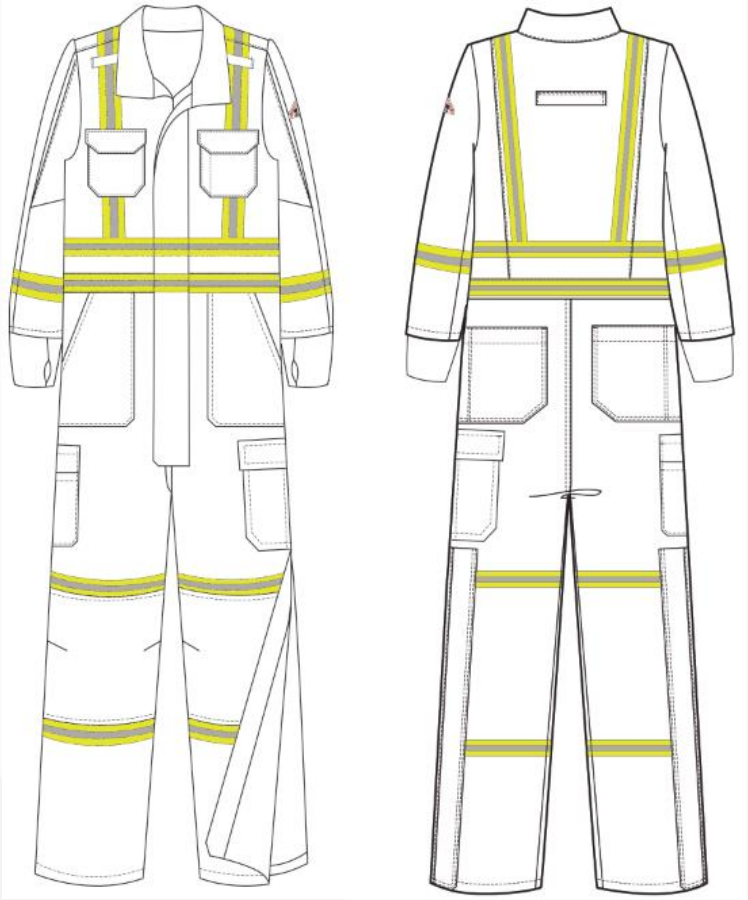
Natural Gas Workers and Natural Gas Fires

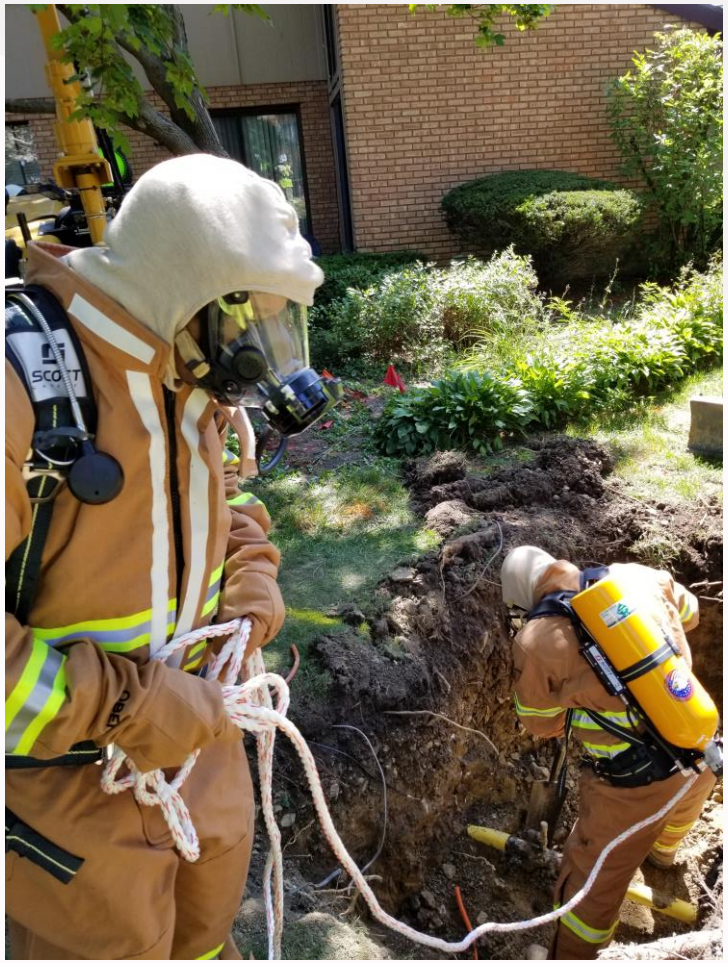
Observations and Analysis of Heat Intensity, Escape Time, Extinguish Time and Flame Resistant Garments

6+ second to escape or extinguish

A new requirement??? - 6 seconds to escape

Off the drawing board - 8 seconds of protection





So, when do we need to wear it….

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
- **6 seconds or more exposure**

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
- **Your day to day and then under your Primary**

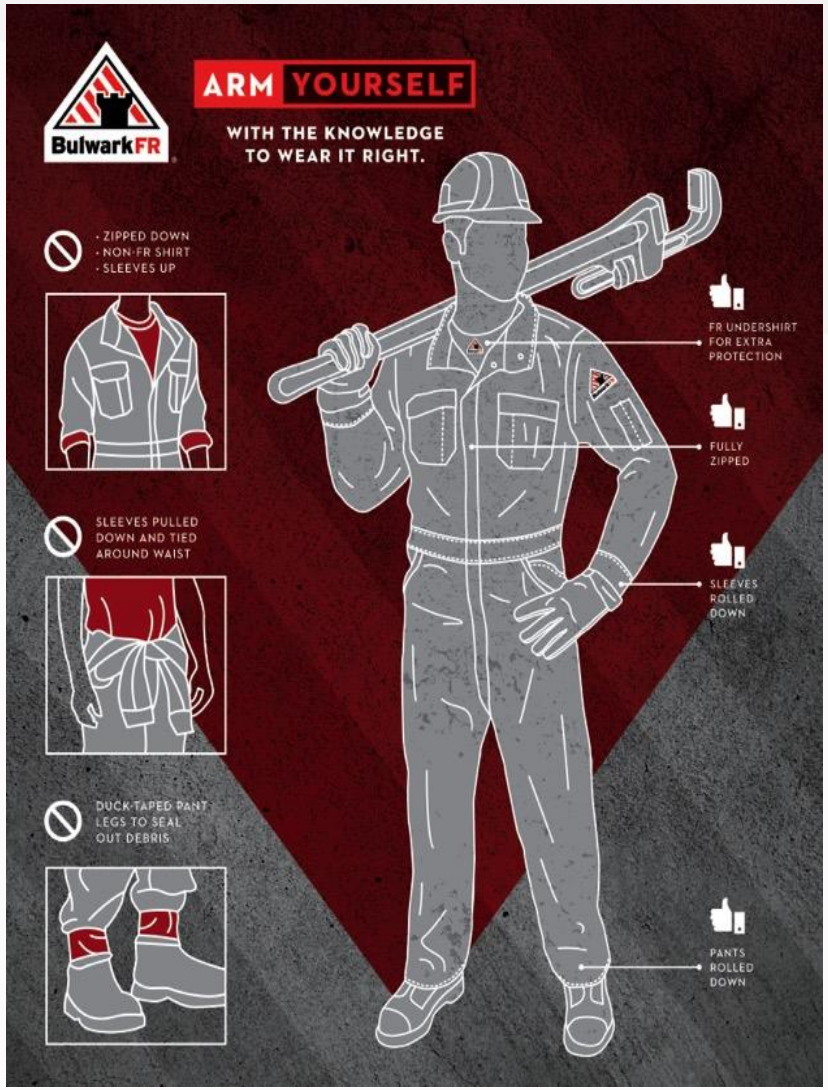
IMPLEMENTATION: Using PPE correctly and effectively in the field

Even the best PPE is pointless if workers don't know how to correctly use the things that are meant to protect their lives. That's why training and instruction in proper use, as well as **"dos and don'ts,"** is critical to an FR program's success.

OIL & GAS – Flash Fire

NFPA® 2113 states that workers must stay “buttoned, rolled, and tucked.”

Undergarments that are not flame-resistant or arc-rated are only permitted if they are constructed of non-melting fabric, such as cotton, silk, or wool.



DO'S

CORRECT

The collar is buttoned up or folded down. The coverall is fully zipped with sleeves and pant legs rolled down to provide full coverage. An FR base layer underneath provides additional protection.

DON'TS

INCORRECT

The coverall is unzipped and sleeves are rolled up or tied around the waist exposing the wearer to the hazard. Ankles are duct taped to seal out dirt and mud preventing easy escape.

DO'S

CORRECT

The shirt is buttoned up and tucked into the pants. The sleeves are rolled down and buttoned. An FR base layer provides additional protection.

DON'TS

INCORRECT

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?

Also, what not to use?

- Coke
- Coffee grounds
- Borax
- Animal fat-based soaps aka “natural”

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.

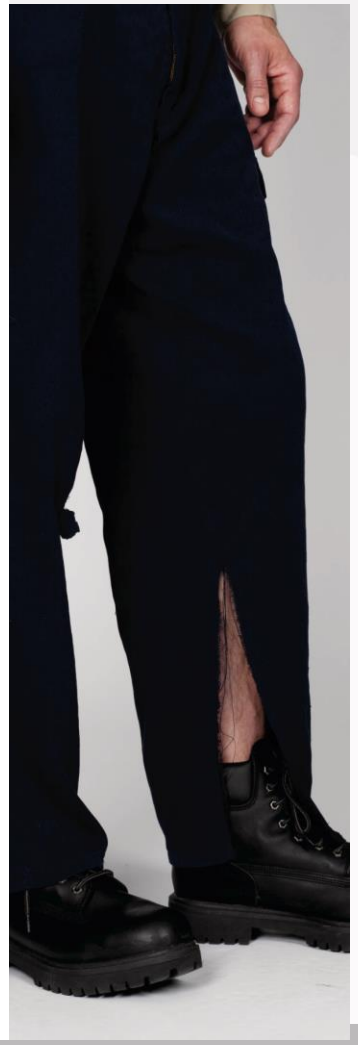
Garments that cannot be safely repaired must be removed from service.

TIPS

Using the viable fabric from retired FR garments for patches and repairs is a safe and economical way to extend the life of FR clothing.

Repairing or Replacing

Garments that cann rom service.



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.**

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

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

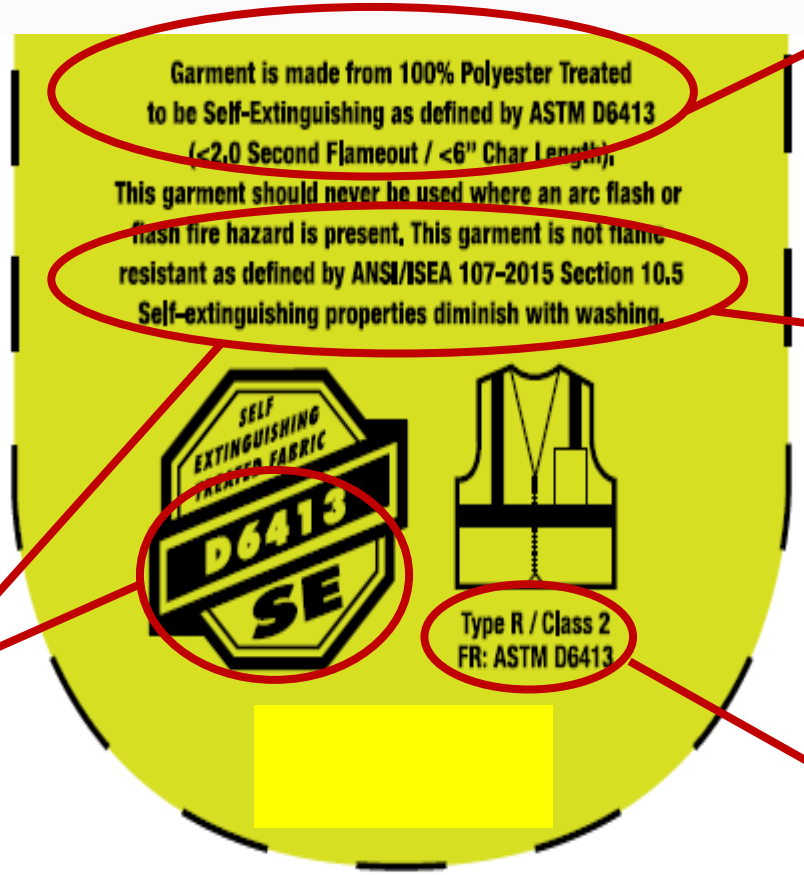
ASTM 1891 – for arc flash

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?



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

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

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

Bottom-line you can wear good stuff or not….

- You can wear the latest and the best or not….
- The difference between good and compliant PPE vs cheap and non-compliant PPE you wont notice until it is too late.
- Bottomline, it doesn’t matter until the pucks start flying.

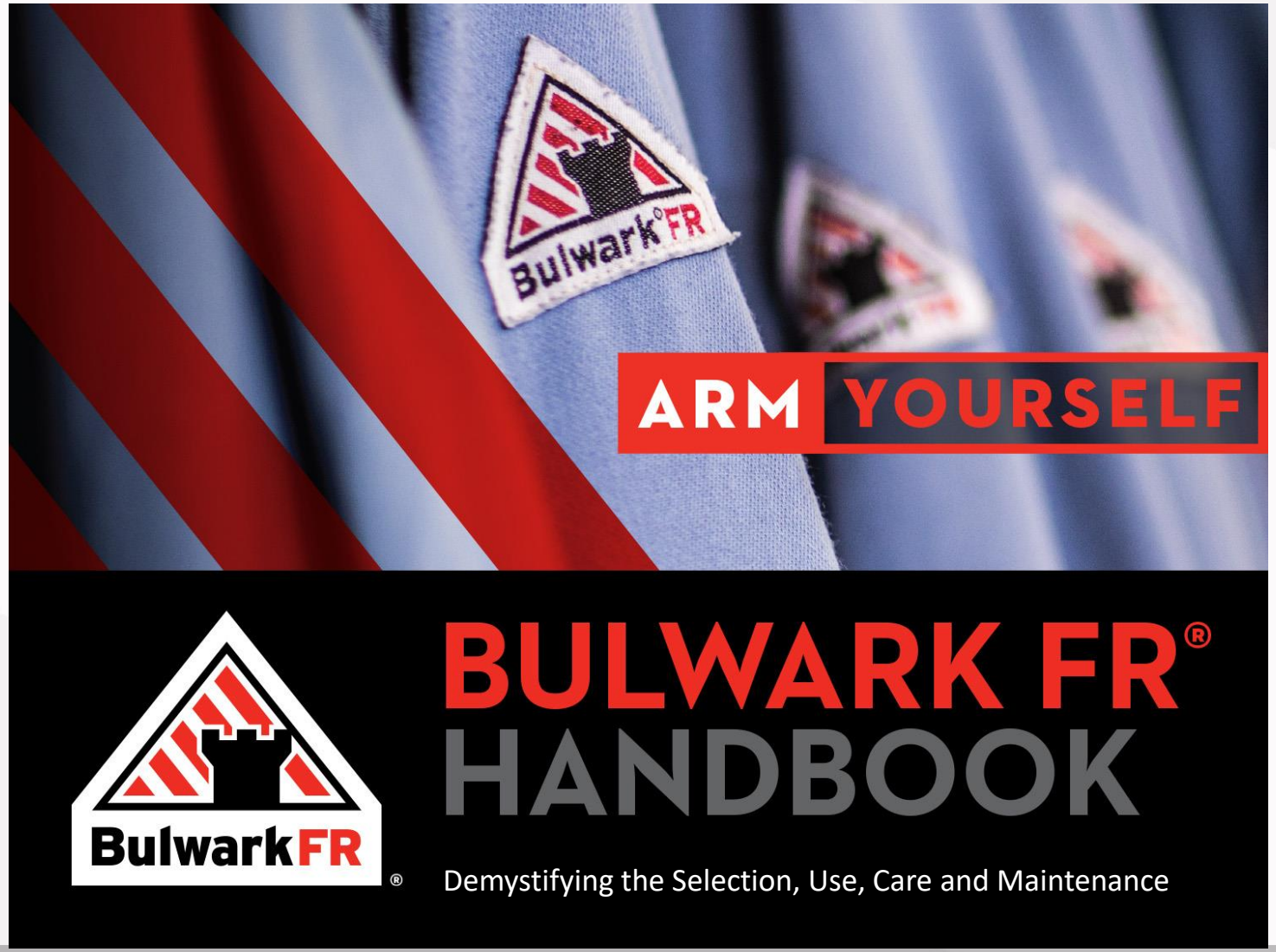
Summary

- Ask for the manufacturer's guarantee in writing on letterhead and signed

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

- Specify that only certified compliant garments for your hazard(s) are allowed on site
- Periodically police your program for compliance
- **Work with proven supply chain partners**

Selection, Use, Care and Maintenance



Easy go to …


Bulwark FR
VOL 17
INDUSTRY UPDATE
SECONDARY FLAME-RESISTANT APPAREL

One last thing to think about….

What you say is important…
but what you do carry's far more weight,
be the example that leads everyone home

THANK YOU

Questions

Bulwark Protection
Derek Sang
derek.sang@bulwark.com