



**TYNDALE**  
PROUD TO PROTECT

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# UNDERSTANDING ARC RATED PPE & EMERGING TRENDS

PPSA June 2024



PROUD  
TO  
PROTECT

# Who We Are

- An industry-leading provider of arc-rated (AR) and Flame Resistant Clothing (FRC) to key industries, including Electric Utilities, 70E, Oil & Gas, and others since 1981
- Tyndale is one of the top 2 FR clothing suppliers in the market, outfitting more than 500,000 wearers across North America, including approximately 95% of investor-owned electric utilities and >50 Fortune 500 companies
- An innovative provider of managed FRC solutions, customized to specific needs
- A manufacturer of a full line of 100% Made in USA FR garments for men and women
- A family-owned and certified woman-owned (WBE) business



# The Role of the FR or AR Garment

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## TO SAVE YOUR LIFE

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AR/FR clothing does not ignite and continue to burn, thus limiting the body surface area and duration of the exposure.

## TO LIMIT OR ELIMINATE INJURY

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AR/FR clothing insulates to the hazard to minimize or prevent 2<sup>nd</sup> degree burns.

# OSHA, NFPA 70E & Arc Flash



OSHA tells us what we **SHALL** do, *but* not **HOW TO** do it



Consensus Standards like **NFPA 70E** tell us **HOW** to do it



**ASTM** standards tell us how to evaluate PPE

What **NFPA 70E** means to **OSHA**:

Evidence the industry acknowledges the hazard

Feasible means of abatement of the hazard

Arc Rated clothing is required where an arc flash hazard exists





**AR CLOTHING**



**NON-AR CLOTHING**



# Arc-Rated vs. Flame Resistant Clothing

**AR**

FR fabrics submitted for **arc flash** testing (ASTM F-1959)

Fabrics that pass are labeled with an **Arc Rating (AR)**

**vs.**

**FR**

Fabrics submitted for **vertical flame** testing (ASTM D-6413)

Fabrics that pass are labeled **Flame Resistant (FR)**

**ALL AR is Flame Resistant**

but

**NOT ALL FR has been Arc-Rated**

Flash Fire Standards: NFPA 2112 & 2113 (ASTM F-1930): Fabrics pass/fail (50% burn at 3 sec)



# Why is Flame Resistant Clothing Needed?

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- Most severe burn energies and fatalities are caused by non-FR clothing igniting and continuing to burn.
- 
- Flame resistant clothing will self-extinguish, thus limiting the area of injury.
- 
- Body area under non-FR clothing is often burned more severely than exposed skin.



# What is a Burn?

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A chemical process which progressively injures skin; severity relates to depth of injury.

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## 1<sup>st</sup> Degree

**Redness, pain – not permanent**

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## 2<sup>nd</sup> Degree

**Blistering – skin will regenerate**

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## 3<sup>rd</sup> Degree

**Total skin depth destroyed – skin will not regenerate and requires grafting**

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# The Bottom Line

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Accidents happen,

“Street Clothing” can and does worsen injury,

you can't do anything about your age,

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BUT

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**YOU CAN DO SOMETHING ABOUT YOUR CLOTHING.**

# Super Slow Motion

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# Poly/Cotton Work Wear

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# 100% Cotton Workwear

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# 11 Cal Arc on FR

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**WARNING – GRAPHIC**







# ARC FLASH & THE TRUTH ABOUT ARC RATINGS

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# What is an Arc Rating?

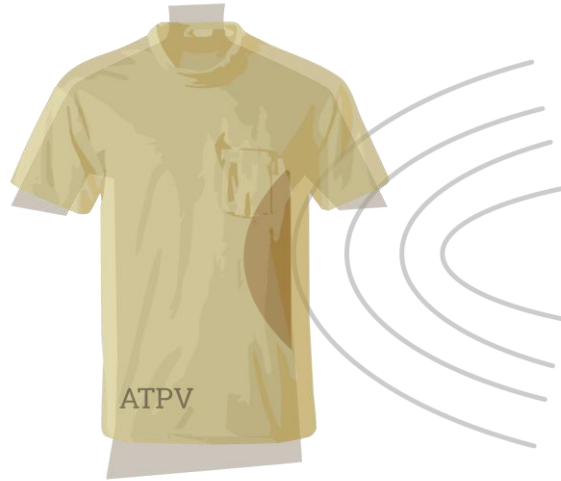
## ASTM F1959 TEST METHOD: Defines Fabric Performance in Electrical Arc Flash

- **ATPV** (Arc Thermal Performance Value) – The incident energy on a material that results in a 50% probability that sufficient heat transfer through the specimen is predicted to cause the onset of second-degree burn injury based on the Stoll Curve, cal/cm<sup>2</sup>
- **Ebt** (Energy Breakopen Threshold) – The incident energy on a material that results in a 50% probability of breakopen. Breakopen is defined as any open area at least 1.6 cm<sup>2</sup> (0.5 in.<sup>2</sup>)

# The Facts on ATPV vs. Ebt Fabrics

## ATPV

ATPV fabrics allow a burn through them before they allow a hole in them.



More Strong than Protective

## BOTH

Protect the wearer from burn injury when the incident energy is below the arc rating of the garment.

## NEITHER

Protect the wearer from burn injury when the incident energy is above the arc rating of the garment.

## Ebt

Ebt fabrics allow a hole in them before they allow a burn through them.



More Protective than Strong

**BOTH PROTECT EQUALLY**



# ASTM F1959 Testing

- Fabric panels are subjected to electric arcs
- Calorimeters measure heat transfer through fabric
- Voltage, amperage, gap and distance are held constant
- Duration (cycles) are varied to achieve higher and lower energies

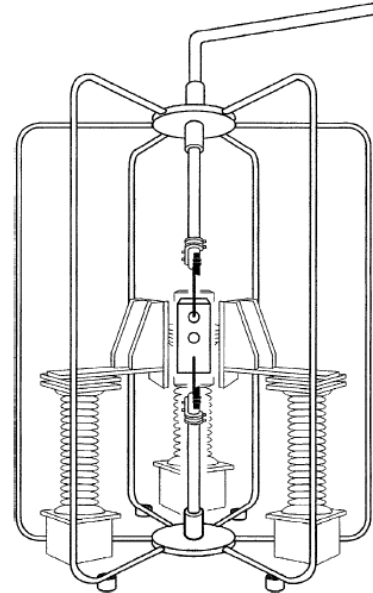


FIG. 7 Supply Bus and Arc Electrodes for Panels

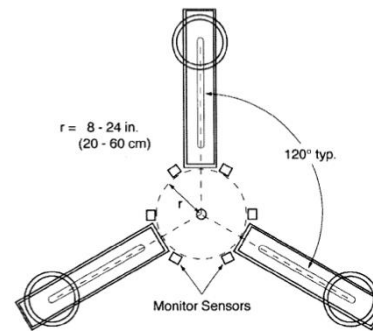
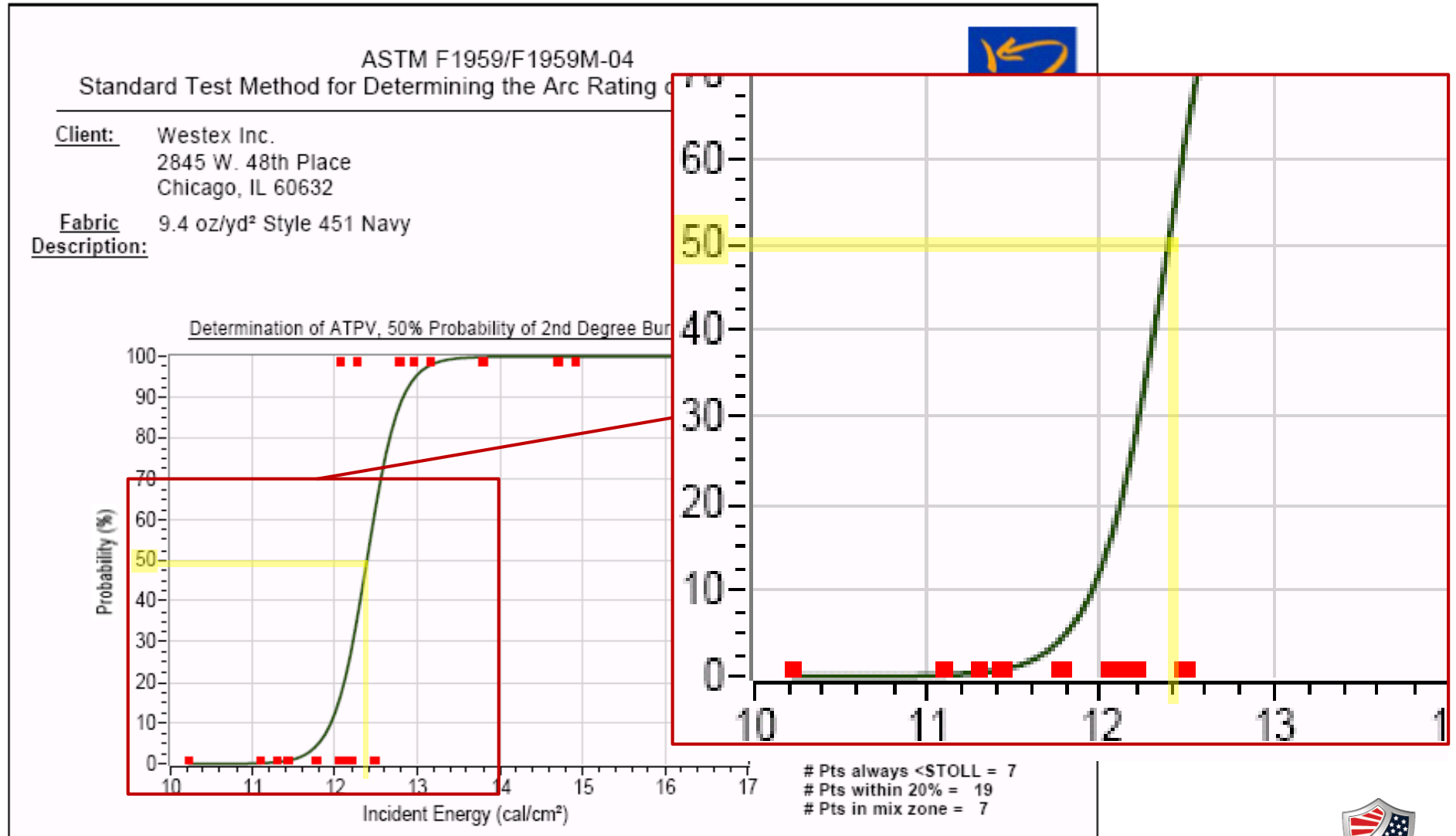


FIG. 1 Arrangement of Three Panel Sensors with Monitor Sensors



# ASTM F1959 – Logistic Regression





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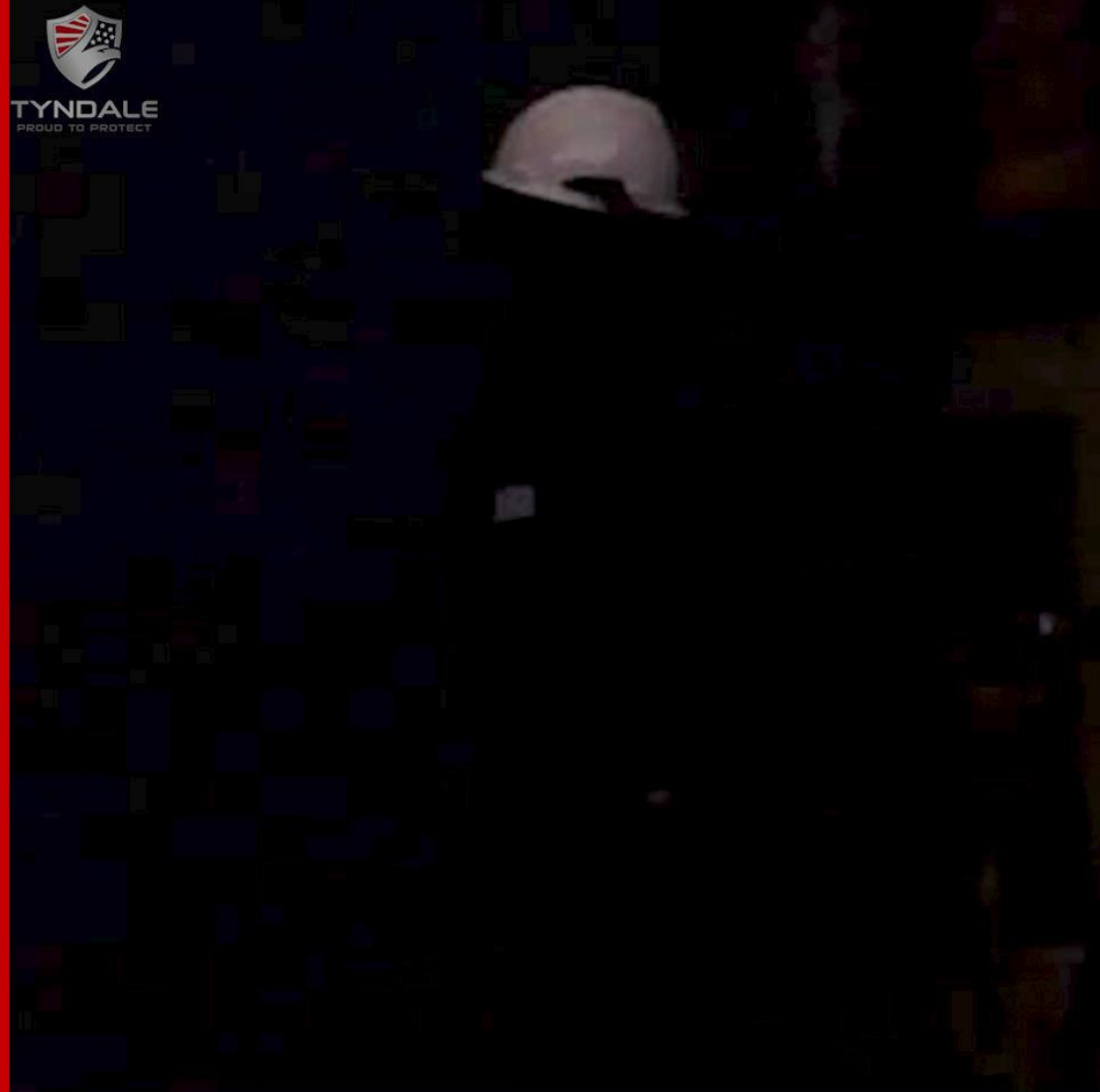
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# DC ARC FLASH

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**Alternating Current (AC) Arc**



**Direct Current (DC) Arc**





# DC Arc vs Cat 2 AR



# DC Arc – 40 Cal suit with Hood Fans



# COMPLIANCE VS. PROTECTION

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THEY'RE NOT THE SAME THING...

# Is Arc Rating All You Need?

## Durability of Flame Resistance to Laundering

Standard	Washes
<b>ASTM F1959</b>	<b>3</b>
<b>ASTM F1506</b>	<b>25</b>
<b>NFPA 2112</b>	<b>100***</b>

\* 100 not forever; \* self submitted; \* perfect laundering

# The Wild West?

70E has removed all mandatory references to third party standards.

**ASTM F1959**

Arc Ratings

**ASTM F1506**

Garment components, labeling, etc.

**Consequences?**



**ASTM F1959**

**ASTM F1506**



# Cat 2 AR & Supervisor in Flammable Clothing



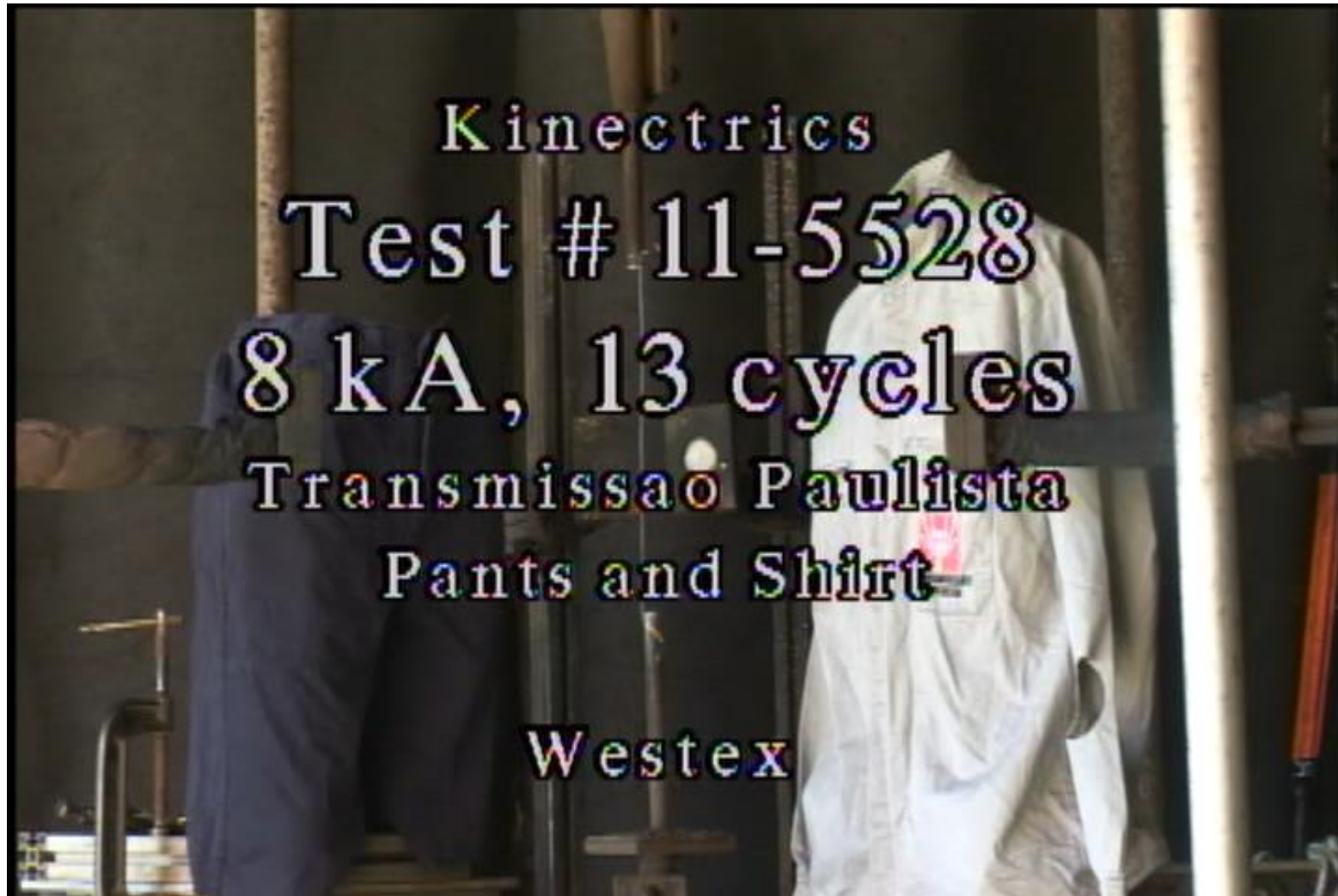
# WHAT HAPPENS IN THE REAL WORLD?

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# “Compliant” Imported Fabric



# Failure of “Compliant” AR





## Ergon Energy workers allergic to uniforms

- Font size: *Decrease* *Increase*
- Email article: *Email*
- Print article: *Print*
- Submit comment: *Submit comment*

Article from: **Courier & Mail**

Anna Caldwell  
September 08, 2008 12:00am

**AT least 143 Ergon Energy workers are breaking out in blisters and vomiting after wearing potentially toxic uniforms recently provided to the workforce.**

The workers have suffered severe allergic reactions to the flame-retardant uniforms recently rolled out to the state's 3400-strong workforce at a cost of about \$3.5 million.

One man had welts that left his back numb, while others reported blistering and rashes covering their groins, arms and nipples.

Workers also claim the Chinese-made uniforms release a yellow, bubbling substance when ironed that causes nausea and vomiting.

Ergon has sent samples of the workwear to the CSIRO for testing but the Electrical Trades Union is demanding a full recall.

While at least 143 workers have lodged health and safety complaints, ETU assistant secretary Peter Simpson said more than 250 workers were affected.

"We only got wind of the problems in August but it looks like a lot of the men were suffering the symptoms in silence," Mr Simpson said.

Lodged complaints don't include members of the workers' families who also have reported symptoms after coming in contact with the uniforms.

Mr Simpson said: "It is a serious issue. We don't know and they aren't telling us what the short and long-term effects of these things are.

"One doctor has advised an Ergon employee that the effects of the chemicals could be cumulative."

An Ergon staff safety directive obtained by The Courier-Mail advised employees last week to continue wearing the new uniforms if they didn't have access to the old variety and had not experienced rash symptoms. If the worker no longer had the old uniform, they were advised to order it and revert to it "as soon as practicably possible".

But Mr Simpson said the response was not sufficient.

<http://www.news.com.au/couriermail/story/0,23739,24308393-3102,00.html>

8/09/2008



# Shrinkage



# COMFORT, HEAT STRESS & FRC

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# What is Comfort? Heat Stress?

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- Comfort is inherently subjective; it cannot be objectively measured or predicted by any single property or group of fiber or fabric properties.
- The best way to evaluate comfort is a wear trial or honest, unedited product ratings.
- Comfort and Heat Stress are two very different things.



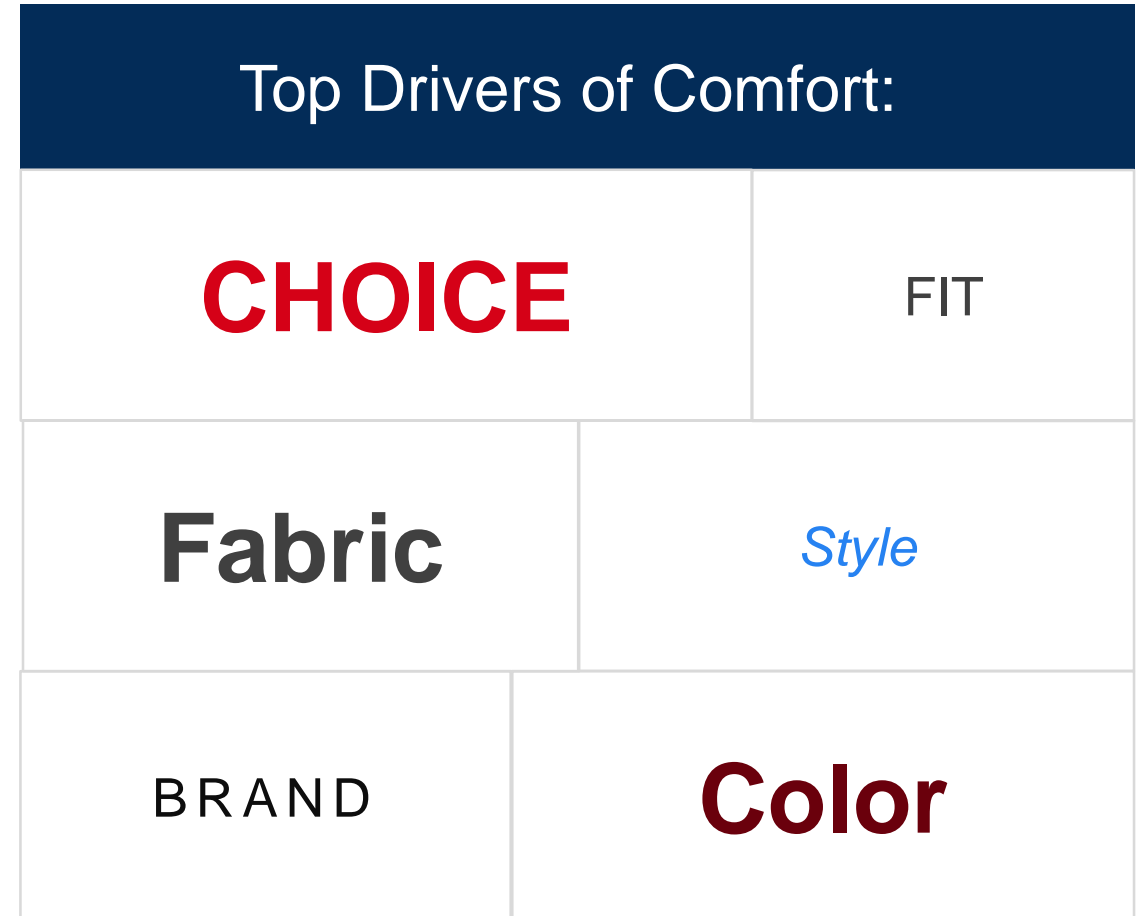
**NO single layer, breathable apparel causes heat stress.  
(OSHA, CDC, Niosh)**

## **Heat stress is caused by:**

- Poor Hydration
- Lack of Shade
- Lack of Rest breaks
- Some Illnesses or Medications
- In PPE: by multiple layer systems or non-breathable garments

# What is Comfort?

- Weight?
- Hand?
- Breathability? (air perm)
- Moisture absorption? (wicking)
- Synthetic vs natural fibers?
- Short sleeves?
- Woven vs Knit?
- Fit?





# Cat 2, 2112, Inherent ... and Less Than 6oz



**A170C**



**FORCE**  
4.7 oz  
8.6 cal



**D18BY**



**GLENGUARD**  
5.3 oz  
9.5 cal



**F169Y**



**TECGEN**  
5.5 oz  
8 cal



**F174Y**



**DH AIR**  
5.5 oz  
9.1 cal



**F17PB**



**EVOLV IQ**  
5.5 oz  
8.5 cal



**D171Y**



**Wrangler**  
**Lightweight**  
**Dobby Weave**  
5.4 oz  
9.5 cal



# IMPROPER WEAR OF AR/FR

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# Partially Unbuttoned Shirt

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# Untucked Shirt

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# Meltable Base Layer

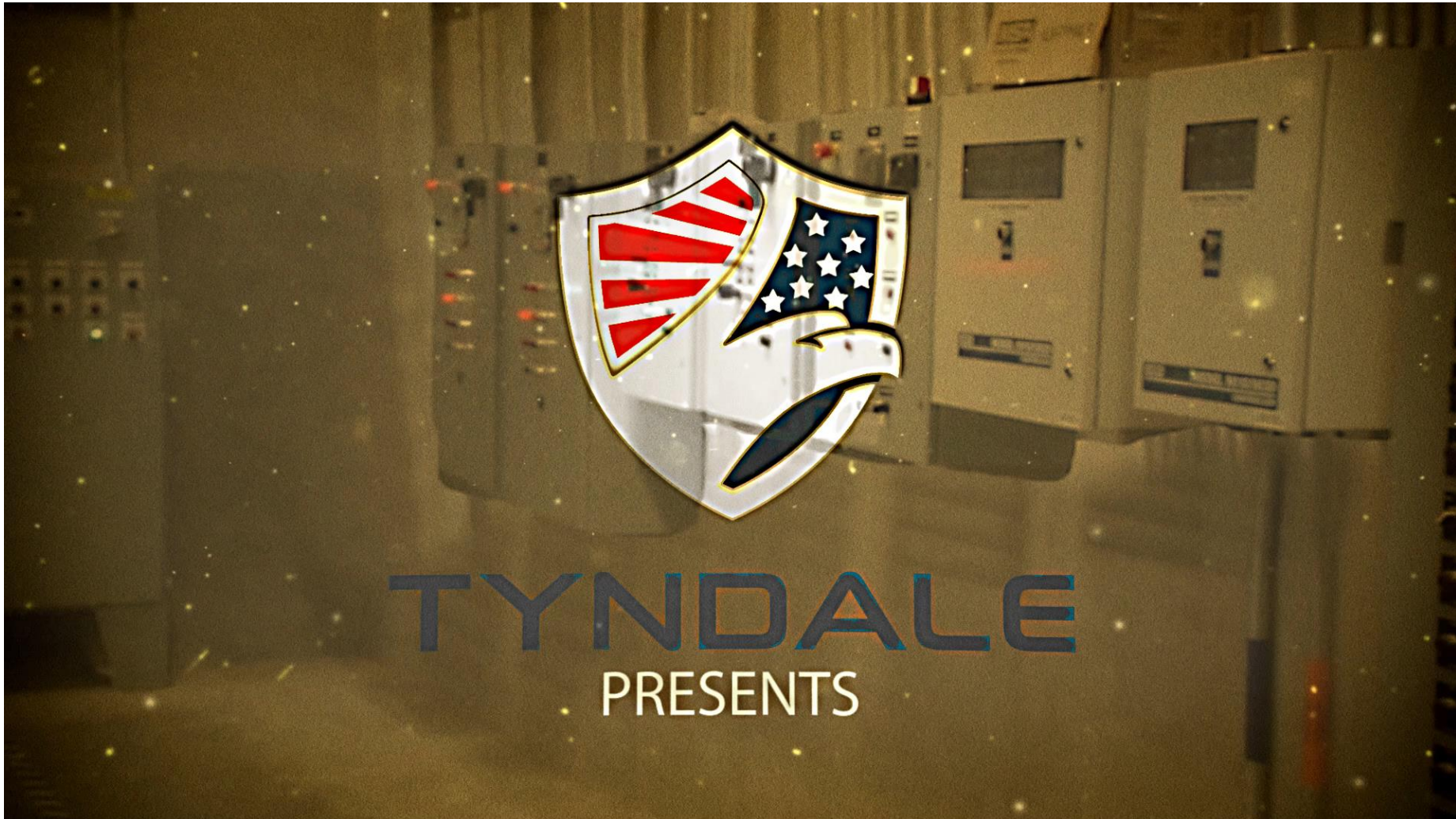
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# MELTABLE BRA UNDER AR SHIRT

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# FLAMMABLE INSECT REPELLENT - DEET

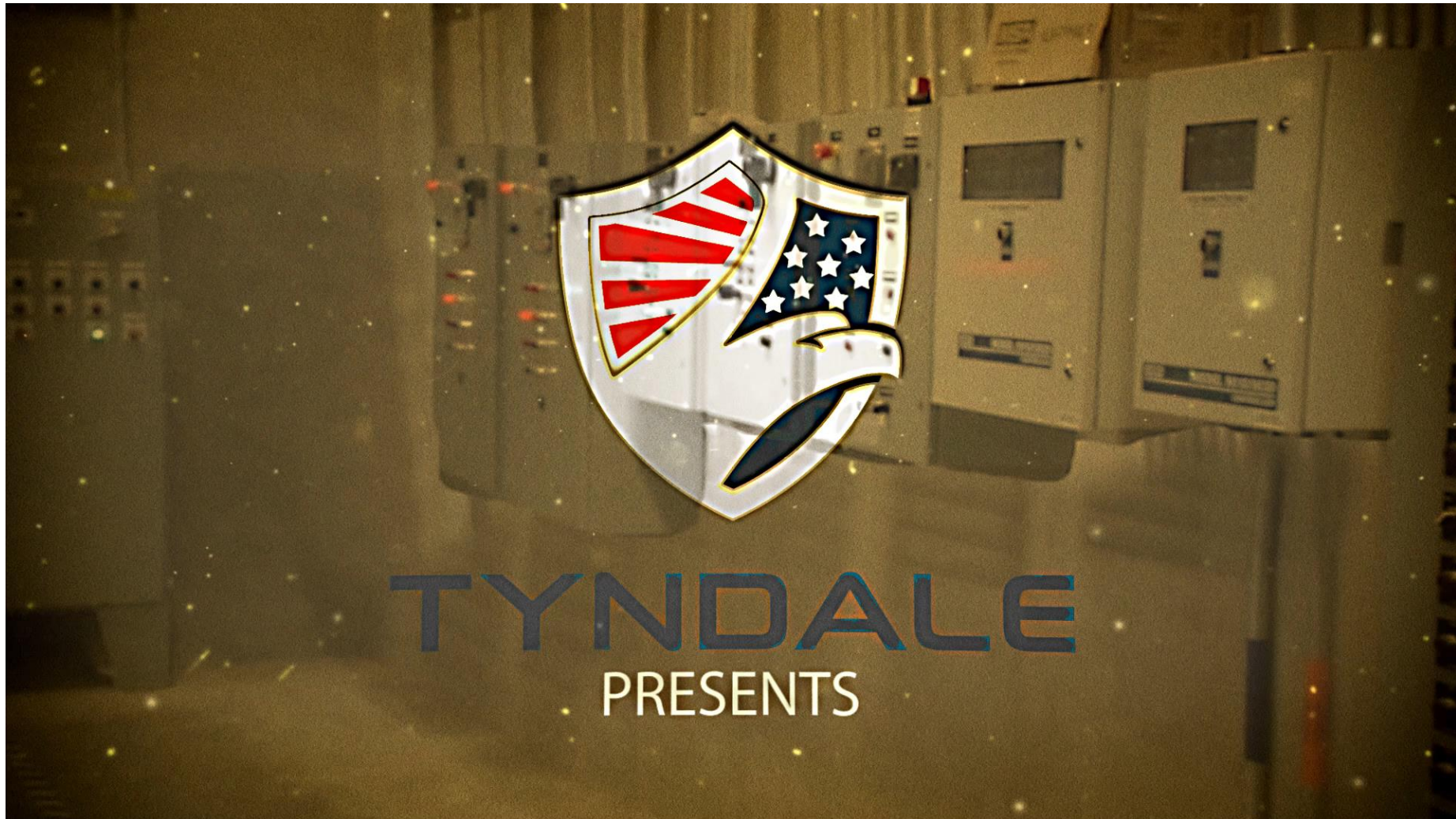
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# PPE NOT RATED FOR THE HAZARD

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# THIRD MAJOR EVOLUTION OF FRC

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# **New World of FRC – Double Edged Sword**

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Huge expansion of:

- Fabric brands**
  - + Fiber blends**
  - + Garment brands**
  - + Test labs in fire and arc**
- 

**Exponential expansion of options, information, data**

**Therefore, more important than ever to have:**

- Knowledgeable, trusted FR resource
- Tight specifications
- Regular monitoring of program
- Top notch, experienced service provider



# Retail – EXTREME CAUTION NEEDED

amazonwarehouse

Bargain Bin Everything 50% off or more [Shop now](#)



[Ad feedback](#)

[Return to product information](#) | Every purchase on Amazon.com is protected by an [A-to-z guarantee](#). | Feedback on this page? [Tell us what you think](#)



## Tyndale Men's FRC FRMC? Layer 1? Performance Long Sleeve T-Shirt SMALL Gray

Tyndale

★ ★ ★ ★ ★ 42 customer reviews | [Share](#)

Size: **Small**

- Small**
- Medium
- MEDIUM-LONG
- Large
- LARGE-LONG
- X-Large
- 2XLARGE-LONG
- 2XLARGE-REGULAR
- 3XLARGE-LONG
- 3XLARGE-REGULAR
- 4XLARGE-LONG
- 4XLARGE-REGULAR
- 5XLARGE-LONG
- 5XLARGE-REGULAR
- XLARGE-LONG
- Lowest offer for each

Color: **Gray**

- Gray**
- Dark Blue
- Gold
- Lowest offer for each

Refine by [Clear all](#)

### Shipping

Free shipping

### Condition

New

Price + Shipping

**\$56.00**

+ \$5.00 shipping + \$0.00 estimated tax

Condition ([Learn more](#))

**New**

Delivery

- **Arrives between** September 22-27.
- Ships from PA, United States.
- [Shipping rates and return policy.](#)

Seller Information

**Tyndale FRC**

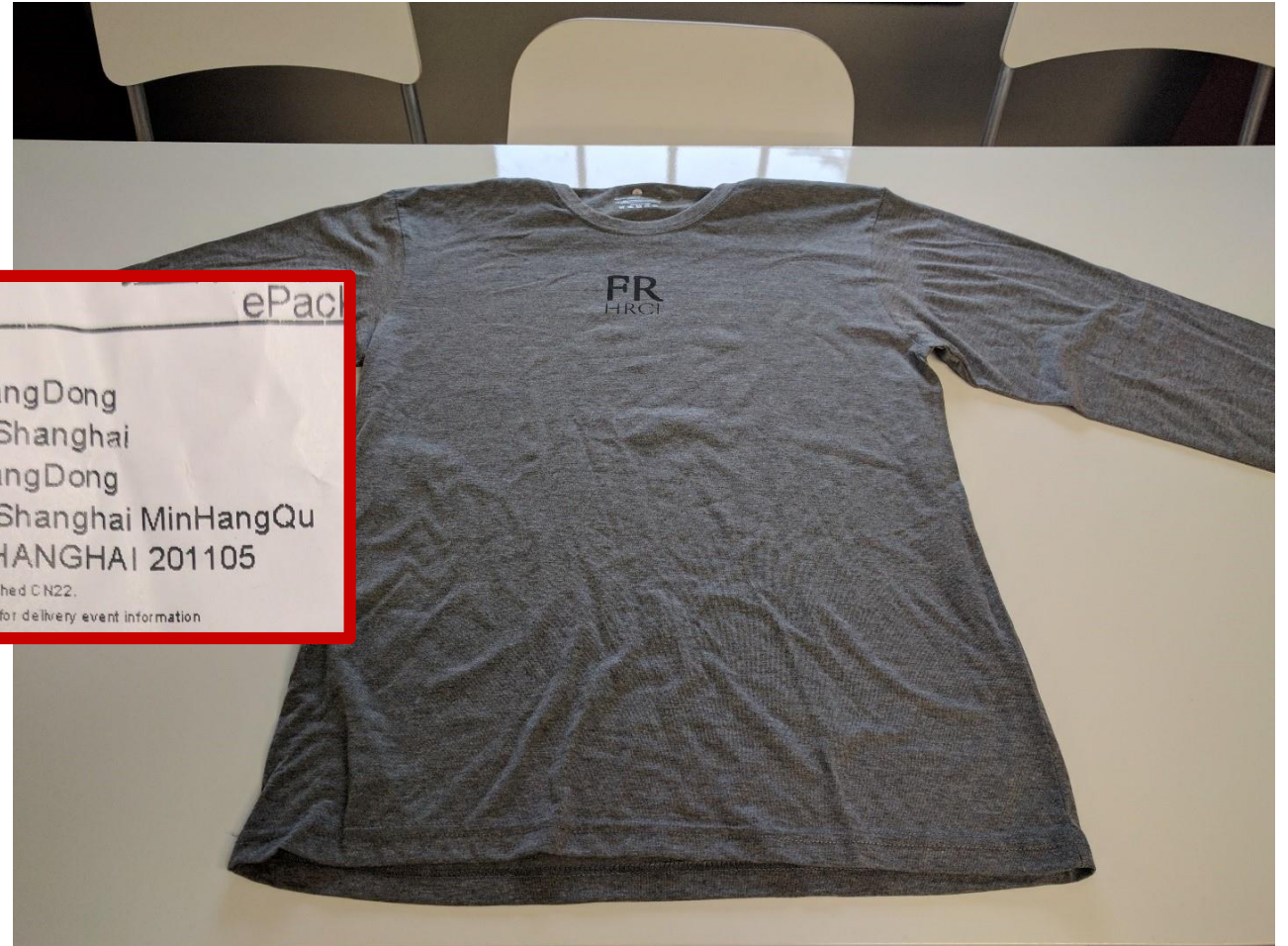
★★★★★ **97%**

**positive** over the past 12 months. (183 total ratings)

Buying Options

Add to cart

# COUNTERFEIT – NOT FR



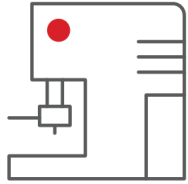
# COUNTERFEIT Warning

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# Trends and the Future of FRC Programs – Garments

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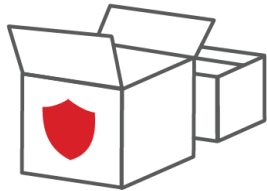
Vastly more garment manufacturers



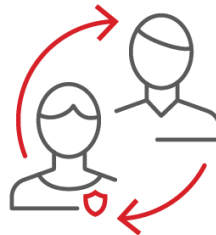
Many more styles/types



FR base layers have arrived (soft, light, affordable)



Branded, lifestyle apparel coming on fast



Boomers aging out, millennials in workforce: implications for style, type and even color



Task-based programs being replaced by daily wear



# Retail Styling is Here

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# Women's Product Line



We believe all workers in the field deserve excellent service. As a result, we're reimagining the AR/FR experience for the women in our managed programs:

- Developed new women's products for our USA-made Versa Collection
- Identified new women's options available from the brands we carry
- Expanded on-hand inventory for women's garments and boots
- Created a catalog of women's boot options



***Nearly 450 women's styles; of these 377 are stocked by our vendor partners and Tyndale stocks 65 of our most popular styles.***

# Laundering & FRC Durability

All quality FR fabrics (but **NOT** all sold) are FR for the life of the garment

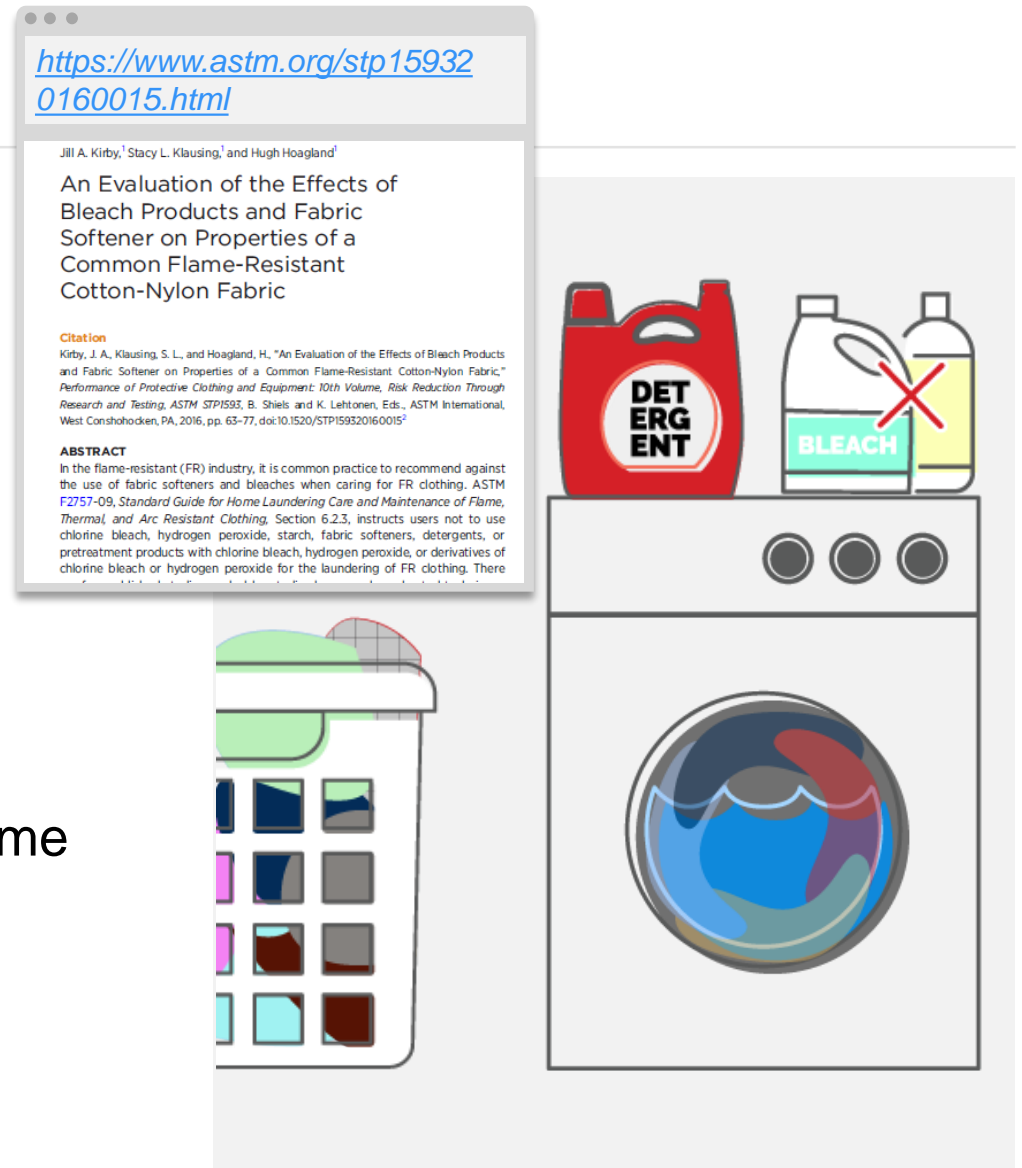
**All garments made or distributed by Tyndale are guaranteed FR for the life of the garment**

All garments sold by Tyndale can be home laundered, dry cleaned, or IL

- ILs generally do not handle knits well
- ILs generally reduce service life of garments vs. Home

**Bleach and fabric softeners prohibited for all FRC**

- Who bleaches colors? Almost no white FRC
- New research shows otherwise

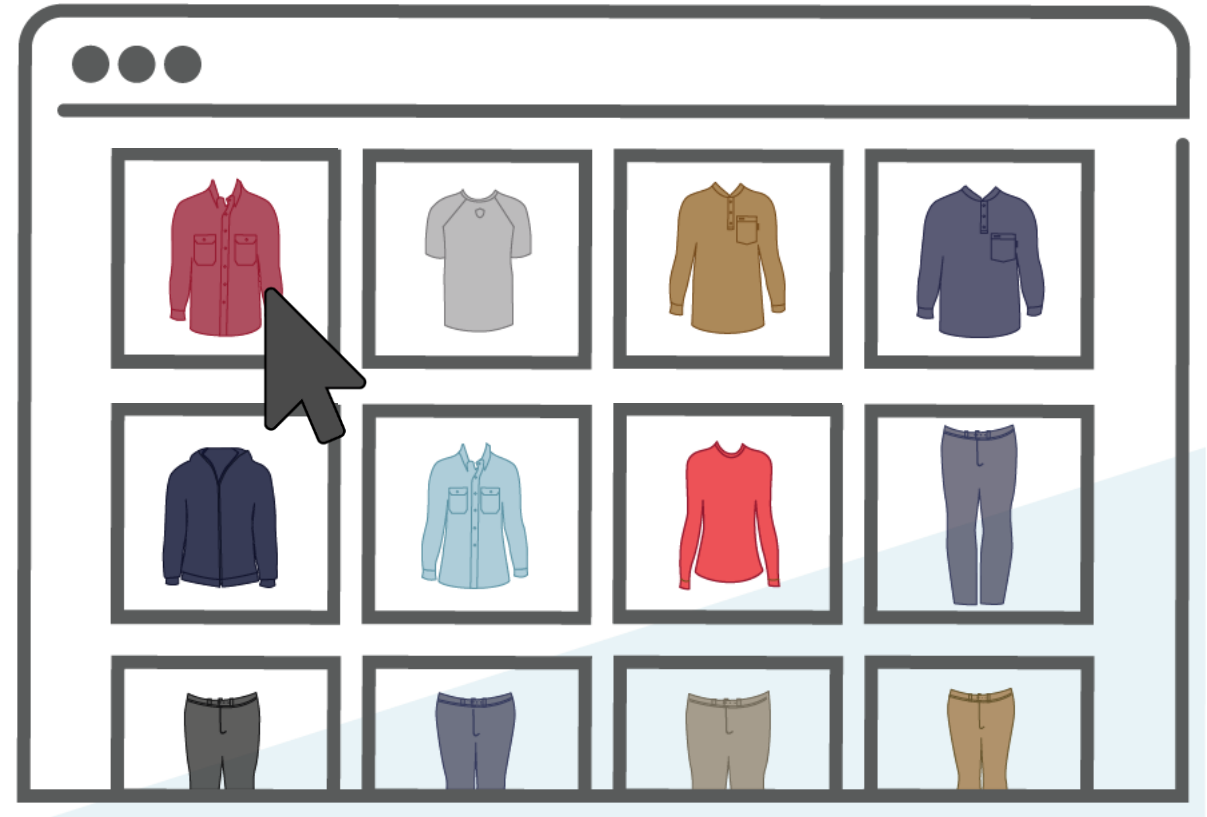


# Trends & the Future of FR Programs

Old delivery models rapidly being replaced (away from IL)

## Trend is moving to Managed Care (esp allowance) programs

- Power of choice
- Access to future innovations
- Reduced headaches
- Expertise & tools
- Often reduced costs



# Catalog Allowance Program



## TYNDALE BASE LAYER T-SHIRT

Item No: **M011T** | Price ~~\$32.60~~ - ~~\$39.15~~



4.6 oz FRMC® Jersey Knit	INHERENTLY FLAME RESISTANT FABRIC	Exterior Tyndale FR labeling
Designed as a baselayer	Moisture wicking & fast drying	Lightweight & breathable technology
Tagless & flat-lock seam construction for comfort		Flash Fire Rated - Meets NFPA 2112
Arc Rating: 4.6 ATPV / CAT 1	Made in USA by Tyndale	

COLORS: Navy Blue, Tan



SIZE	S	M	LRG	XL	2XL	3XL
RG LENGTH	✓	✓	✓	✓	✓	✓
LN LENGTH	✗	✓	✓	✓	✓	✗

## TYNDALE LAYER 1™ LONG SLEEVE T-SHIRT

Item No: **M010T** | Price ~~\$38.50~~ - ~~\$46.20~~



4.6 oz FRMC® Jersey Knit	INHERENTLY FLAME RESISTANT FABRIC	Designed as a baselayer
Moisture wicking & fast drying	Tagless & flat-lock seam construction for comfort	Lightweight & breathable technology
Exterior Tyndale FR, arc rating, and CAT labels	Flash Fire Rated - Meets NFPA 2112	Arc Rating: 4.6 ATPV / CAT 1
Made in USA by Tyndale		

COLORS: Navy Blue, Tan



SIZE	S	M	LRG	XL	2XL	3XL
RG LENGTH	✓	✓	✓	✓	✓	✓
LN LENGTH	✗	✓	✓	✓	✓	✗

## CARHARTT FORCE™ LONG-SLEEVE HENLEY

Item No: **J060C** | Price ~~\$52.70~~ - ~~\$63.15~~



6.75oz 100% Cotton FR Jersey Knit	Force fabric wicks away sweat	Lightweight & Breathable technology
Rib-knit henley collar and cuffs	Left chest pocket	Sideseamed construction minimizes twisting
Flash Fire Rated - Meets NFPA 2112	Arc Rating: 8.9 ATPV / CAT 2	Imported by Carhartt

COLORS: Dark Navy, Khaki



SIZE	S	M	LRG	XL	2XL	3XL	4XL
RG LENGTH	✓	✓	✓	✓	✓	✓	✓
LN LENGTH	✗	✓	✓	✓	✓	✓	✗



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# OSHA ACTION?

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TO  
PROTECT



# Bipartisan Congressional Action

Congress of the United States  
Washington, DC 20515

May 17, 2021

Mr. James Frederick  
Principal Deputy Assistant Secretary for  
Occupational Safety and Health  
U.S. Department of Labor  
200 Constitution Avenue, NW  
Washington, DC 20210

Dear Principal Deputy Assistant Secretary Frederick:

Congratulations on your new role and your career advocacy on behalf of the health and safety of American workers. Now more than ever the mission of your agency is critically important. As you begin your important work with the agency, we write to support and encourage more rigorous and comprehensive analysis of industry interpretations for arc-rated (AR) clothing and associated personal protective equipment (PPE).

According to industry estimates, more than 600,000 American workers performing work on or near energized electrical equipment are needlessly exposed to deadly arc-flash related injuries and hazards on worksites across the country without protection. We understand that this exposure is due to the continued lack of compliance with Occupational Safety and Health Administration (OSHA) OSHA and industry standards for AR clothing requirements that have been in place for over two decades. This non-compliance has a significant human and financial cost, as workers who are exposed to these threats face life-threatening risk from arc-hazard events.

It has come to our attention that OSHA currently maintains a requirement for AR clothing by using National Fire Protection Association (NFPA) Standard 70E, "Standard for Electrical Safety in the Workplace". NFPA 70E is evidence that there remains a problem with AR hazards within

Congress of the United States  
Washington, DC 20515

standards for PPE requiring appropriate arc flash PPE during all live electrical work performed in the United States. We applaud OSHA for having the necessary policies and regulations in place to make this significant and meaningful update for arc-flash hazards. Thank you for your consideration of this issue of significant importance to our districts as you begin your important work.

Sincerely,



Donald Norcross  
Member of Congress



Brian Fitzpatrick  
Member of Congress



Mark Pocan  
Member of Congress



Linda T. Sánchez  
Member of Congress

/s/

Haley Stevens  
Member of Congress

# Bipartisan Congressional Action

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Congress of the United States  
Washington, DC 20510

May 14, 2021

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Principal Deputy Assistant Secretary for  
Occupational Safety and Health  
U.S. Department of Labor  
200 Constitution Avenue, NW  
Washington, DC 20210

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On behalf of our constituents and the 600,000 essential American workers required to work on energized equipment, we encourage OSHA to adopt an enforcement policy citing existing standards for PPE requiring appropriate arc flash PPE during all live electrical work performed in the United States. We applaud OSHA for having the necessary policies and regulations in place to make this significant and meaningful update for arc-flash hazards. Thank you for your consideration of this issue of significant importance to our districts as you begin your important work.

Sincerely,



Mike Braun  
U.S. Senator



John Hickenlooper  
U.S. Senator

# OK, BUT DOES THIS STUFF WORK IN THE REAL WORLD?

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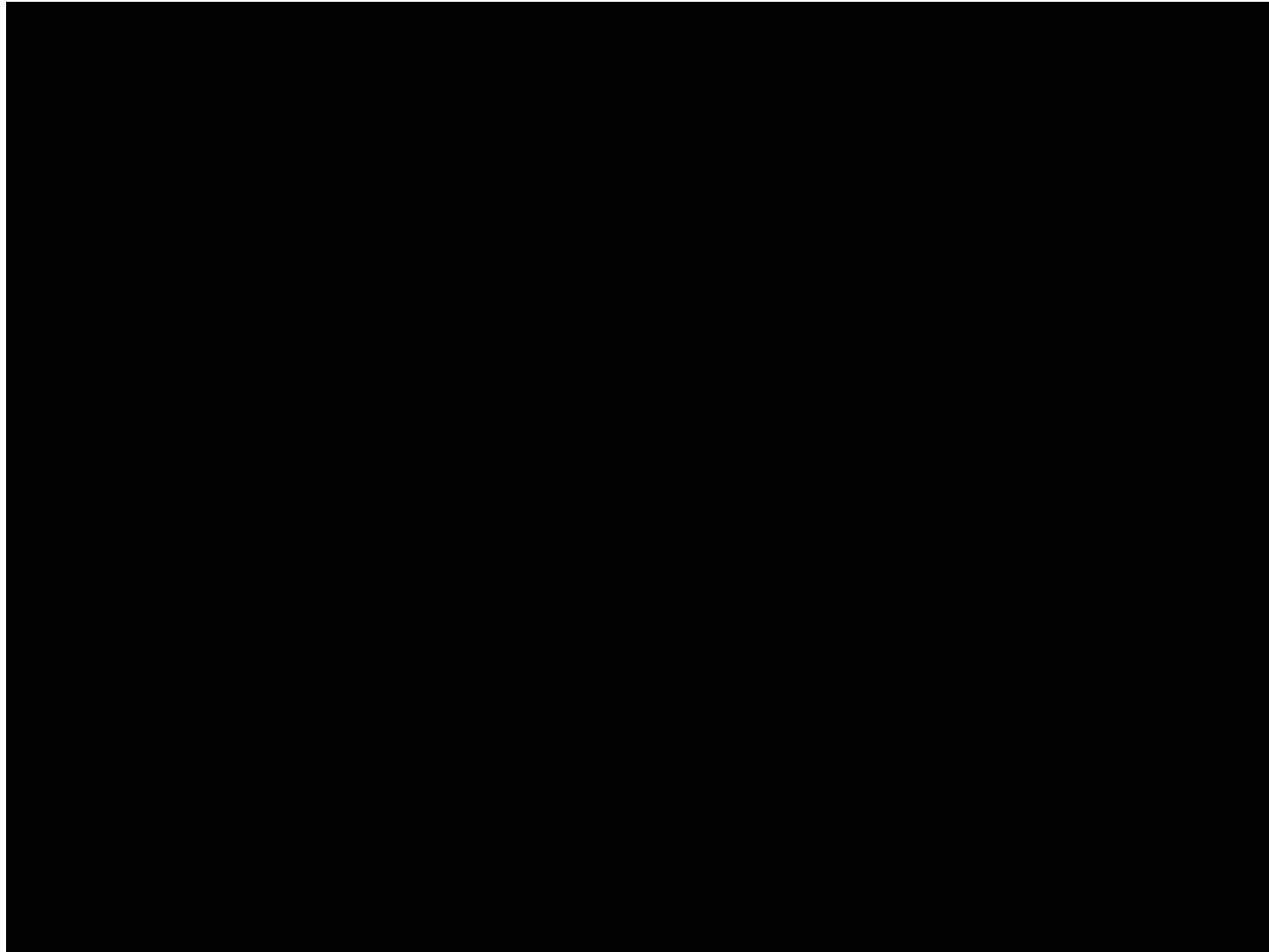
# Wearing FRC





# Brazil – 10 cals – AR Clothing

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# KEY TAKEAWAYS

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Don't Wear Fuel

Choice = Comfort

Wear Properly

Service Matters

THANK YOU

