
# BULWARK FR® HANDBOOK

Selection, use, care and maintenance – it's the law?????

# Demystifying the Selection, Use, Care & Maintenance of FR/AR Clothing

# The proper selection of PPE is very important.

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

You will be introduced to the regulations, the standards and the general "best practices" that are utilized in the selection, use, care and maintenance of FR/AR garments for arc flash and flash fire hazards.

## 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 his 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 his employees;

**1910.132(d)(1)** The employer shall assess the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of personal protective equipment (PPE).

## SELECTION: 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."

As with hazard assessment, industry consensus standards may be used to guide selection decisions. (NFPA 70E/2112/2113)

# OIL & GAS – FLASH FIRE

The primary known hazard is flash fire, a rapidly moving flame front that expands through diffuse fuel without creating blast pressure.

NFPA® 2112 and NFPA® 2113 are the “go-to” industry consensus standards that address flash fire.

NFPA® 2112 lays out the standards that FR garments must meet in order to enter the market (covering everything from the capabilities and characteristics of the fabrics, to construction of the garment, the types of closures to be used, and comfort).

NFPA® 2113 focuses on how organizations and the correct garment based on certain criteria.

# GENERAL INDUSTRY – 70E Arc Flash Protection

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

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

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$^2$.

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**

# ELECTRIC UTILITY – ARC FLASH PROTECTION

Employers must protect workers from potential burn injury by estimating the available heat energy that the workers could be exposed to and by selecting and providing personal protective clothing and equipment.

**METHODS OF CALCULATING INCIDENT HEAT ENERGY FROM AN ELECTRIC ARC**

**NFPA 70E–2004, Annex D,**

**IEEE Std 1584–2002.**

**Heat Flux Calculator**

**ARCPRO**

**Doughty, Neal, and Floyd paper**

Employers must ensure that the employee outer most layer be flame-resistant/arc rated clothing with an arc rating that matches the potential threat

# VERIFYING PROTECTION

## (WHERE TO START - UNDERSTANDING LABELS)

Even after assessing hazards and correctly selecting the appropriate FR/AR clothing, it is the responsibility of the employer to verify that the garments match the identified hazard - NFPA® and ASTM labeling requirements help, but not everyone follows the rules.


### ASTM F1506 6.3 requires that:

Garments shall be labeled with the following information:

6.3.1 **Tracking identification code system**,

6.3.2 Meets requirements of Performance Specification F1506

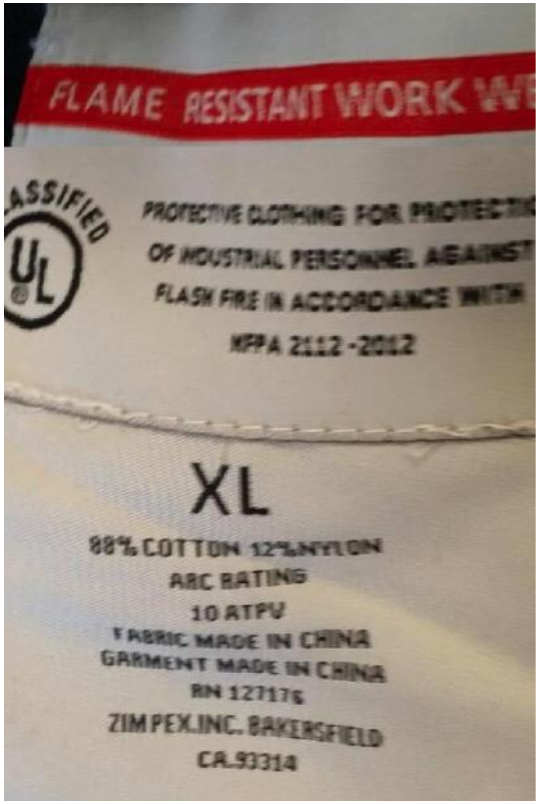
6.3.3 Manufacturer's name,

6.3.4 Size and other associated standard labeling,

6.3.5 Care instructions and fiber content, and

6.3.6 Arc rating (ATPV) or arc rating (EBT).

6.3.6.1 When garments are made with a different number of fabric layers in different areas of the garment, the arc rating for each area shall be designated. Pockets, trim, closures, seams, labels and heraldry shall not be considered as extra layers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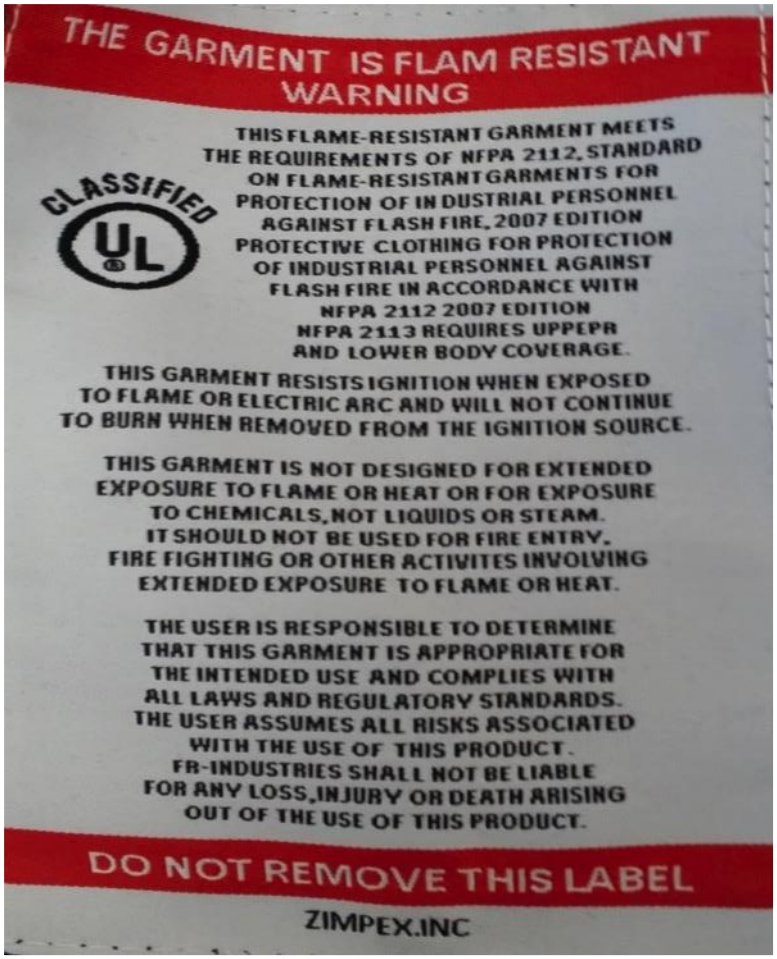
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THE REQUIREMENTS OF NFPA 2112, STANDARD
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PROTECTION OF IN DUSTRIAL PERSONNEL
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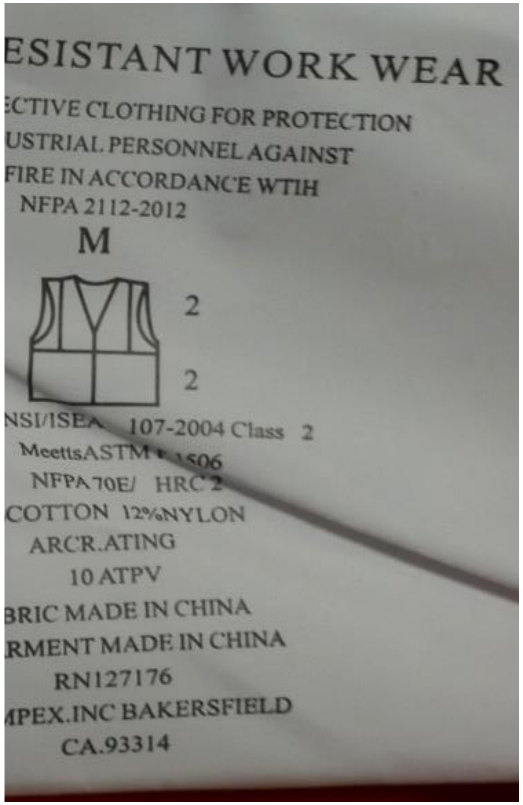
PROTECTIVE CLOTHING FOR PROTECTION
OF INDUSTRIAL PERSONNEL AGAINST
FLASH FIRE IN ACCORDANCE WITH
NFPA 2112 2007 EDITION
NFPA 2113 REQUIRES UPPEPR
AND LOWER BODY COVERAGE.
THIS GARMENT RESISTS IGNITION WHEN EXPOSED
TO FLAME OR ELECTRIC ARC AND WILL NOT CONTINUE
TO BURN WHEN REMOVED FROM THE IGNITION SOURCE.
THIS GARMENT IS NOT DESIGNED FOR EXTENDED
EXPOSURE TO FLAME OR HEAT OR FOR EXPOSURE
TO CHEMICALS, NOT LIQUIDS OR STEAM.
IT SHOULD NOT BE USED FOR FIRE ENTRY.
FIRE FIGHTING OR OTHER ACTIVITES INVOLVING
EXTENDED EXPOSURE TO FLAME OR HEAT.
THE USER IS RESPONSIBLE TO DETERMINE
THAT THIS GARMENT IS APPROPRIATE FOR
THE INTENDED USE AND COMPLIES WITH
ALL LAWS AND REGULATORY STANDARDS.
THE USER ASSUMES ALL RISKS ASSOCIATED
WITH THE USE OF THIS PRODUCT.
FR-INDUSTRIES SHALL NOT BE LIABLE
FOR ANY LOSS, INJURY OR DEATH ARISING
OUT OF THE USE OF THIS PRODUCT.
DO NOT REMOVE THIS LABEL
ZIMPEX.INC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ARC RATING
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RMENT MADE IN CHINA
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MPEX.INC BAKERSFIELD
CA.93314

# WHAT CAN GO WRONG HERE?

## NEED TO KNOW

Anything worn over FR/AR garments must be tested to the hazard, or the whole system is potentially compromised. Look for rainwear and high-visibility vests that have been tested to ASTM 2733 for flash-fire or have been tested to ASTM 1891 for arc-flash and have an ATPV.

Noncompliant rainwear and vests can pose a serious threat to an otherwise solid FR/AR clothing program. It's confusing when manufacturers market their products as "FR" by referencing a single test method such as ASTM D6413-08, non-performance based standards like ASTM F2302-08, or even non-garment standards like NFPA® 701.

***Check your labels!***

# SOME STANDARDS ALONE ARE NOT ENOUGH; SOME ARE JUST WRONG

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

** ANSI 107 – 2015 Changes in FR labeling requirements will help

# TRAINING

Employers implementing a PPE program are required by OSHA 1910.132(f)(1)10 to provide training to each employee.

According to OSHA, each employee who is required to wear PPE should at least know when it is necessary, what exactly is necessary, how to don and doff and adjust it, what its limitations are, and how to properly care for it.

In addition to the requirement that employees be trained to use PPE properly, OSHA points to other specific industry consensus standards that provide even more specific details for example NFPA®2113

# 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.

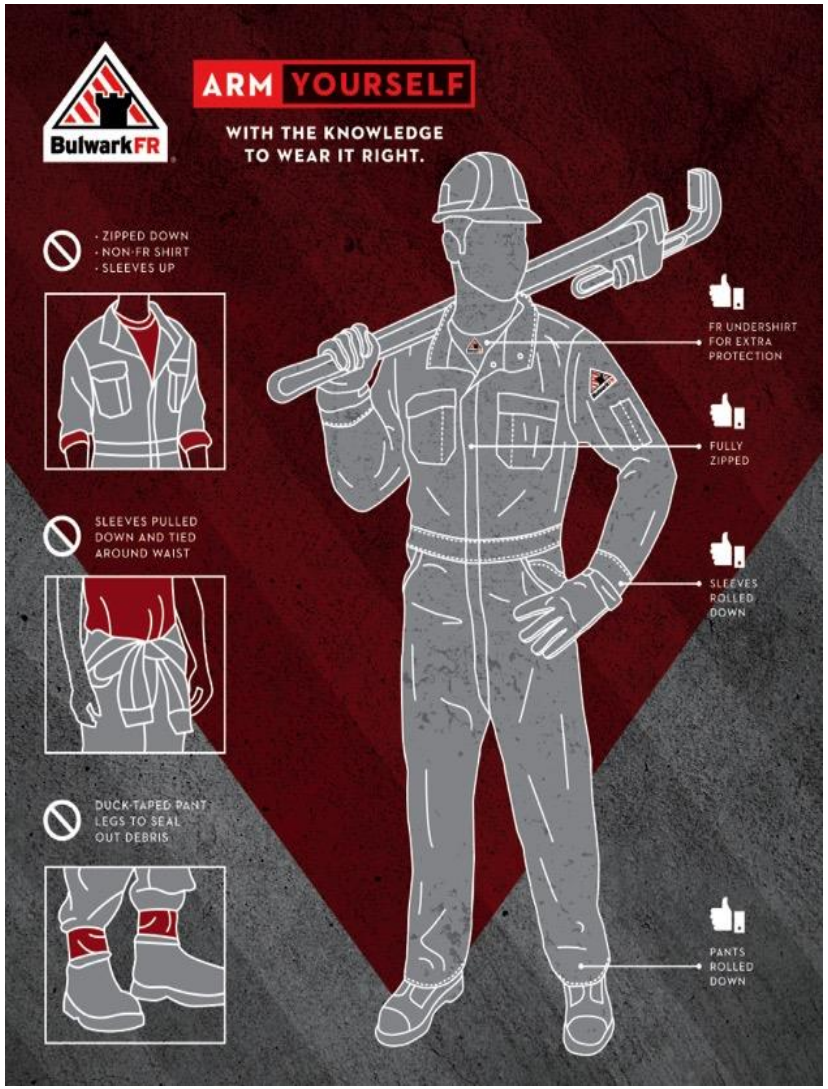
# IMPLEMENTATION: USING PPE CORRECTLY AND EFFECTIVELY IN THE FIELD

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 "do's 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.



# GENERAL INDUSTRY – ARC FLASH PROTECTION

The correct use of arc-rated PPE in general industry was updated in 2012

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

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.

# ELECTRIC UTILITY – ARC FLASH PROTECTION

Until recently (April, 2014) many utility workers wore arc-rated shirts along with non-FR cotton jeans or pants..

The OSHA Regulations 1910.269 and 1926.960 are now aligned and require that all electric utility workers wear arc-rated clothing with an arc rating that is equal to or greater than the potential hazard.

ASTM 1506 Xl.2.l Clothing should cover potentially exposed areas as completely as practicable. This should include proper interfacing of related items.

# FR/AR BASICS FOR LAYERING

Eliminates the two major problems:

First - in an arc flash and/or a flash fire the threat of break open is real exposing either the naked skin or the lightweight non-FR/AR undershirt to thermal energy causing injury or worse potential ignition adding to the injury.


FR/AR base layers add an additional layer of protection and eliminate the potential of under garment ignition

Second - eliminates the need to police under garments and attempt to insure that all employees are safe.

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# MELTING UNDERGARMENTS

The concern is **REAL!**

# WHICH BASE LAYER IS CORRECT FOR ME?

# 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

Shirt is untucked and open.
Sleeves are rolled up.
Undergarment is flammable,
and the hat is non-FR.

# ALWAYS – ROLLED, TUCKED AND BUTTONED!

# CARE & MAINTENANCE: PROTECTING THE PPE 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 Launderin
Clothing or See Guide ASTM F1449 S
Arc Resistant Clothing concerning ca

## 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.

## 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.

- Important to read the manufacturers 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**

# LAUNDRY TIPS

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

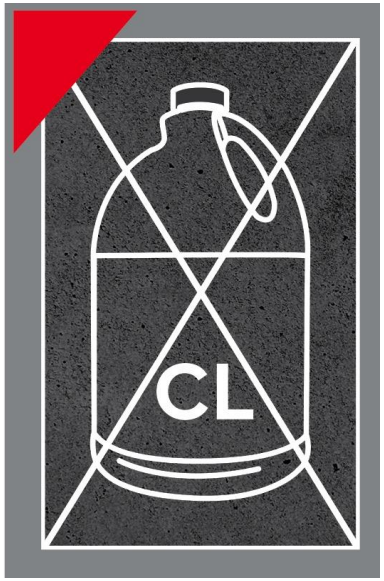
**6**. Avoid the hottest temperature to reduce the impact of shrinkage

**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 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?

# IMPORTANT TO READ THE LABEL


# SOILED GARMENTS

- Discoloration/stains alone are not an indicator of reduced protection
- Monitor the accumulation of secondary accelerants on your garments throughout the day.
- After laundering make sure accelerants are removed. SNIFF!!
- Rewash the garment until the odor is gone.

## STAINS

Visible stains are not necessarily a sign of contamination, but a garment that smells of oils, solvents, or any flammable substance must be re-laundered or retired.

# 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.


TEARS

## Checklist: for the Selection, Use, Care & Maintenance of FR/AR Clothing

- ✓ Ask for the manufacturers guarantee in writing on letterhead and signed
- ✓ Ask for the test data for the hazard (fabric suppliers can readily supply these results)
- ✓ Ask to see the garments certification(s) (has every garment been tested to your hazard?)
- ✓ Specify that only certified compliant garments for your hazard(s) are allowed on site
- ✓ Work with a proven supply chain partners
- ✓ Periodically police your program for compliance

# QUESTIONS/ COMMENTS

Request a PDF of the Handbook
http://www.bulwark.com/Contact