FR CLOTHING FOR LABORATORIES

TECHNICAL BRIEF

Workrite® FR CP™

Flame Resistant / FR
Chemical-Splash Protection / CP

Workrite® FR CP™

Personal protective equipment (PPE) for laboratory workers, including safety glasses or goggles, gloves, breathing masks, and lab coats, play an important role in lab safety.

Lab coats have been used for decades, but they have typically been made from cotton or polyester/cotton blends with the primary purpose being to keep foreign materials off of the clothing worn under the coat. Flame-resistant (FR) lab coats have also been available for years, but they have not been widely used. However, the use of FR lab coats in university labs has become increasingly important due to a number of recent accidents related to fire and clothing ignition.

Flammable lab coats and regular clothing can — and will — make a dangerous situation far worse if they catch fire. In 2008, a female University of California Los Angeles (UCLA) research assistant was severely burned when the chemicals she was working with ignited, catching her clothing on fire and leaving her with fatal second- and third-degree burns on nearly half of her body. Her tragic death has brought problematic, outdated safety policies, procedures and PPE at universities across the country to light.

THE VALUE OF FR LAB COATS

In addition to the emotional devastation of human injury and loss, universities and labs face a number of costly scenarios in the aftermath of lab accidents, including a loss of research funding, lawsuits, surging insurance costs and reputation damage. One of the swiftest ways to increase the safety of lab workers is to outfit them in FR lab coats.

A variety of classes of flammable and combustible liquids are common in labs, as is made evident by reviewing this list of more than 90 chemicals.

CLASS I-A FLAMMABLE LIQUIDS

- Acetaldehyde
- Ethylamine
- Chloroethane
- Ethyl Ether
- Ethyl Mercaptan
- Isopropylamine
- 2-Methylbutane
- Propylene Oxide
- Tetramethylsilane
- Trichlorosilane

CLASS I-B FLAMMABLE LIQUIDS

- Acetone
- Acetyl Chloride
- Acetonitrile
- Benzene
- Cyclohexane
- I, 2-Dichloroethane
- Diethylamine
- Ethyl Acetate
- Ethyl Alcohol >50%
- Gasoline
- Hexane
- Isopropyl Alcohol
- Methanol
- Methyl Ethyl Ketone
- Petroleum Ether
- Pyridine
- Tetrahydrofuran
- Toluene
- Vinyl Acetate
- Triethylamine

CLASS I-C FLAMMABLE LIQUIDS

- Amyl Acetate
- Azidotrimethylsilane
- I-Butanol
- Chlorobenzene
- Dicyclopentadiene
- Ethylenediamine
- Hydrazine
- Methyl Isobutyl Ketone
- 2-Methyl-I-Propanol
- Morpholine
- Nitromethane
- 2,4-Pentanedione
- I-Pentanol
- Propyl Alcohol
- Styrene
- Trichloroethylene

CLASS II COMBUSTIBLE LIQUIDS

- Acetic Acid > 80%
- Acetic Anhydride
- Boron Trifluoride
- Etherate
- Cyclohexanone
- Decane
- Diesel (Fuel Oil No. 2)
- N,N-Dimethyl Formamide
  Dimethylaminoethanol
- Formaldehyde
- Formic Acid
- Kerosene
- 2-Methoxyethanol
- 3-Methyl-I-Butanol
- Propionic Acid
- Thiophenol
- WD-40® Lubricant

CLASS III-A COMBUSTIBLE LIQUIDS

- Acetophenone
- Aniline
- Benzaldehyde
- Benzoyl Chloride
- Benzyl Bromide
- Benzylamine
- Butyric Acid
- Diethyl-Pyrocarbonate
- Dimethyl Sulfate
- N,N-Dimethylacetamide
- Dimethylsulfoxide
- Ethanolamine
- Hexyl Alcohol
- 2-Mercaptoethanol
- I-Methyl-2-pyrrolidinone
- Nitrobenzene
- I-Octanol
- Phenol

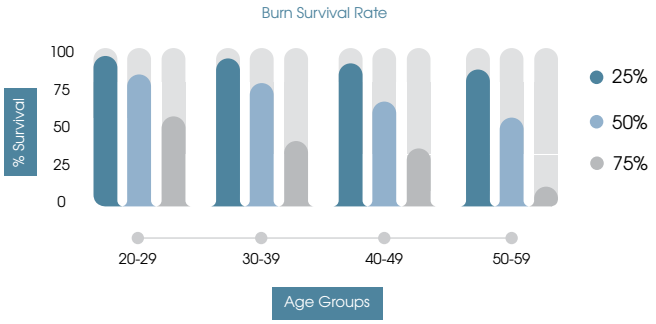
CLASS III-B COMBUSTIBLE LIQUIDS

- p-Anisaldehyde
- Benzyl Alcohol
- 2-Bromoethanol
- Diethanolamine
- Ethylene Glycol
- Formamide
- Glycerol
- Hexadecane
- Hexanoic Acid
- Hydraulic Oil (generic)
- Methyl Salicylate
- Mineral Oil (generic)
- Oxalyl Chloride
- Polyethylene Glycol
- Transformer Oil (generic)
- Triethanolamine
- Triton X®
- Tween 20®

SURVIVING BURN INJURIES

As a result of the abundance of flammable and combustible liquids that exist in labs, many commonly reported lab incidents involve fire. FR lab coats can help protect the wearer against these accidents by preventing clothing ignition, which in turn minimizes the potential severity and amount of burn injury.

Note: An FR lab coat will not prevent ignition of non-FR clothing worn underneath the coat, such as pants, if they are exposed to fire. Full-body FR protection may be needed in some scenarios where hazards exist.



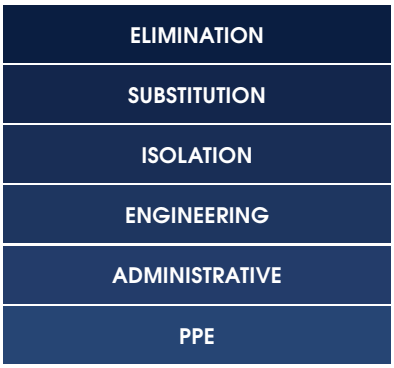
Unlike non-FR garments, FR clothing does not ignite and continue to burn when the flame source is removed. It also provides a barrier from the flames and insulates the wearer from some of the heat generated by these flames. Overall, FR clothing provides three basic benefits:

1. **It can reduce the amount and severity of burn injuries.**
2. **It can provide the wearer with some time to escape a fire area.**
3. **It can increase the wearer's chances of survival.**

As demonstrated in this graph from the National Burn Information Exchange, as the percentage of body burn increases, the chances of surviving a flash fire decrease significantly. Regardless of age, keeping the amount of body-burn injury low, which is exactly what FR clothing is designed to do, helps increase the likelihood of survival.

LABORATORY ACCIDENT CONTROL

Controlling laboratory accidents requires a multi-method approach. This chart shows some of the methods that can be used to reduce the possibility of accidents and thus improve the safety of lab workers. However, while eliminating the cause of accidents and/or instituting engineering controls and safety procedures can play critical roles, having the proper PPE as a last line of defense is equally important.



SAFETY PROGRAM HIERARCHY OF CONTROL

The safety program hierarchy of control starts with instituting a culture of safety. From there, programs establish engineering/technical solutions, followed by the implementation of proper work practices and procedures. Finally, safety programs mandate the use of the proper PPE as the last line of defense against accidents.

SAFETY STANDARDS

OSHA 1910.1450

OCCUPATIONAL EXPOSURE TO HAZARDOUS CHEMICALS IN LABORATORIES

This rule applies to all employees engaged in the laboratory using hazardous chemicals. Training shall include the measures employees can take to protect themselves from exposure to hazardous chemicals such as appropriate work practices, emergency procedures and personal protective equipment (PPE). The appendix also provides guidance to the use of PPE in labs.

Appendix Section A – General Principles:

Perform risk assessments for hazardous chemicals and procedures prior to laboratory work, select appropriate controls including PPE to minimize risk, and wear lab coats and gloves when working with hazardous materials.

Appendix Section B Responsibilities – Laboratory Personnel

Use PPE as appropriate for each procedure that involves hazardous chemicals.

Appendix Section D – Chemical Hygiene Plan (CHP)

Implement a plan which sets forth PPE, engineering controls, apparel and chemical handling, where trained laboratory workers should ensure that proper engineering controls and PPE are in place.

Appendix Section E – General Procedures for Working with Chemicals

Wear appropriate PPE at all times.

OSHA LABORATORY SAFETY GUIDANCE BOOKLET

The booklet makes reference to both PPE for chemical exposure and fires in labs. It makes reference to the OSHA PPE standard – 29 CFR 1910.132 – which requires employers to provide and pay for PPE, and ensure that it's used wherever "hazards such as chemical hazards are encountered in a manner capable of causing injury or impairment in the function of any part of the body through physical contact."

It also makes reference to 29 CFR 1910.1450 noted above. There is a specific section related to fire where it states, "Fire is the most common and most serious hazard that one faces in a typical laboratory." It continues by stating, "Wear proper clothing and personal protective equipment."

NFPA 45

STANDARD ON FIRE PROTECTION FOR LABORATORIES USING CHEMICALS

NFPA 45 is a national consensus standard written to establish the requirements for fire protection in laboratories. The purpose is to provide basic requirements for the protection of life and property through prevention involving the use of chemicals in laboratory-scale operations. The standard is designed to control hazards and protect personnel from the harmful effects of chemicals as a result of fire or explosion.

SECTION 6.6 – FIRE-RETARDANT CLOTHING

- 6.6.2 Fire-retardant lab coats shall be worn where pyrophoric reagents are used outside the inert atmosphere of a glove box.
- 6.6.5 Fire-retardant clothing shall meet the requirements of NFPA 2112.

WHY NOMEX® IIIA LAB COATS?

Although lab coats are available in more than one FR-fabric type, those made with Nomex IIIA fabric are particularly well suited for the lab environment. Nomex IIIA-based fabrics offer excellent flash-fire protection, as well as the ability to resist degradation from chemical contact, such as exposure to many acids, corrosives, oxidizers and reducers.

WHAT ABOUT CHEMICAL-SPLASH PROTECTION?

Inadvertent chemical-splash accidents are a common occurrence in many labs, and traditional, woven lab coats generally don't provide adequate protection. For instance, garments designed to specifically protect against small chemical-splash hazards may not be FR, which is not a suitable compromise. Additionally, there are also second-layer aprons or vests that are both chemical-splash protective and FR, but they are typically uncomfortable, in that they don't breathe well and restrict a wearer's range of motion, and therefore are not always worn when needed.

NEW WORKRITE FR/CP LAB COAT FEATURING WESTEX® SHIELDCXP!

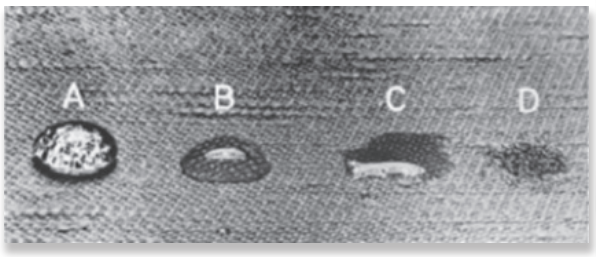
Workrite Uniform's new Workrite FR/CP Lab Coat is made from flame-resistant (FR) Nomex IIIA with a proprietary, chemical-splash protection (CP) technology — Westex ShieldCXP™. This innovation is designed to shed small amounts of liquid chemicals when they are dropped or splashed on the fabric, as well as resist these chemicals from wicking through the fabric onto the wearer, thus reducing the potential for chemical burns. Additionally, ShieldCXP has proven to be durable for up to 50 industrial launderings for many liquid chemicals, lasting even longer for many others. Since lab coats are not laundered frequently, ShieldCXP should last for years.

(Experiment comparing a swatch of Nomex IIIA with ShieldCXP to a common FR lab coat fabric when exposed to a Piranha Solution (3 parts Sulfuric Acid / 1 part Hydrogen Peroxide). The solution pools on the fabric with ShieldCXP, without penetration, while it quickly burns through the other.)

The Workrite FR/CP Lab Coat is designed for use in a laboratory environment for inadvertent liquid chemical splashes at atmospheric pressure — not for continued exposure or use under pressure. The types of chemicals that ShieldCXP is generally effective against include aqueous chemicals and mixtures, and polar organic solvents. ShieldCXP is not as effective against non-polar organic solvents.

The table below provides a list of liquid chemicals and chemical solutions that have been tested on Nomex IIIA with ShieldCXP, using a modified AATCC 193 test method. Each liquid has been given a rating based on the visual representations of the interaction of the liquid with the surface of the fabric. The method uses an A-D rating scale to rate the interaction. An "A" rating corresponds to no interaction with the fabric while a "D" rating indicates complete wicking of the solvent across and through the fabric. Ratings "B" and "C" are intermediate designations. See the "AATCC 193 Visual Rating Guide" for examples of each rating.

AATCC 193 VISUAL RATING GUIDE



Rating of the Degree of Wetting or Wicking

A = None *B = Slight* *C = Partial* *D = Complete*

ShieldCXP is effective against chemicals with "A" or "B" ratings but is not recommended for those with a "C" or "D" rating. The user should check the properties of their specific liquid hazard chemicals and test them against ShieldCXP to be sure the fabric works properly, as not all chemical solutions, variations of chemicals or concentrations have been tested. Chemicals that ShieldCXP is generally effective against include aqueous chemicals and mixtures, and polar organic solvents. See chart below for more information.

MODIFIED AATCC 193 TEST METHOD

There are countless liquid chemicals, and combinations thereof, that could be tested and rated according to the modified AATCC 193 Test Method.

A finite list of challenge chemicals was selected, including those listed in the ASTM F1001-12 standard.

These challenge chemicals are designed to represent a broad range of chemical classes, hazards and physical characteristics, and although they have been tested, they do not represent a complete list of chemicals that are used in a laboratory environment.

The following ratings were recorded:		Westex® ShieldCXP 4.5 oz/yd²	Other FR Fabric** 6 oz/yd²
Corrosive Liquids	98% Sulfuric Acid*	A	D
	37% Hydrochloric Acid	A	D
	40% Hydrofluoric Acid	A	D
	50% Sodium Hydroxide*	A	D
Strong Oxidizers and Corrosive Liquids	70% Nitric Acid	A	D
	Piranha Solution	B	D
	50% Hydrogen Peroxide	A	D
Polar Organic Solvents	Acetonitrile*	A	D
	Carbon Disulfide*	A	D
	Dimethylformamide	A	D
	DMSO	A	D
	Nitrobenzene*	A	D
	Tetrachloroethylene*	A	D
	Methanol*	A	D
	Ethanol	B	D
	i-Propanol	A	D
Non-Polar Organic Solvents	n-Heptane	C	D
	n-Hexane*	D	D
	Acetone*	D	D
	Dichloromethane*	D	D
	Diethylamine*	D	D
	Tetrahydrofuran*	D	D
	Toluene*	D	D
	Ethyl Acetate*	D	D

The fabric ratings in the above chart represent fabric as produced (without laundering)
* Included on ASTM F1001-12 list of liquid challenge chemicals
** FR fabric tested was standard Nomex® IIIA (without ShieldCXP technology)

FOR WHAT INDUSTRIES IS THE WORKRITE FR/CP LAB COAT WELL SUITED?

Industries that run the risk of flash fire, electric arc flash and/or liquid chemical hazards would benefit from the use of the Workrite FR/CP Lab Coat. Liquid chemistry products can include: acids, bases, oxidizers, pharmaceuticals, agriculture products, cleaners, coating, paints and beyond. Additionally, the hazards of flash fire and chemical splash can be present in occupations that require working with:

- UTILITY EQUIPMENT
- FOOD PROCESSING
- BATTERIES
- MEDICAL LABORATORIES
- MACHINERY AND TRANSPORTATION
- LABORATORY CHEMICALS
- AGRICULTURE PRODUCTS AND FERTILIZERS

Our mission is to protect today's workers by delivering trusted, innovative and market-leading, flame-resistant branded apparel solutions.

If you have questions regarding lab coats, please contact:

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