



Springfield DH

Dual-Hazard FR Fabric

Objective

This paper is intended to educate the reader about Springfield's new, inherently flame-resistant (FR) fabric. Springfield DH is engineered to provide permanent protection against flash fires and electrical arc flashes. It is important that a flame-resistant (FR) garment provide an expected degree of protection to the wearer. This paper will address key expectations to consider when making a decision on which fabric provides the optimum protection, comfort, and durability.

Introduction

The FR protective fabric market continues to change with the introduction of new fibers and finishes. U.S. sales of protective clothing rose to \$1.6 billion in 2012, up from \$1.5 billion in 2011, and are expected to reach \$2.3 billion in 2017. Research teams are being asked to work alongside workers in muddy oil fields to figure out how to turn the typical firefighter-like gear into lighter, more breathable clothing. (“What the Well-Dressed Fracker is Wearing,” WSJ, May 15, 2013).

New and innovative products blend a variety of existing fibers into fabrics with demonstrable advantages over existing products. Permanent FR protection is achieved inherently versus using chemical treatments to make normally flammable fabrics exhibit FR characteristics.

Today’s market is asking for solutions in protective apparel that address the following criteria:

- 1. Cost** – Can FR garments be produced that are also cost effective and provide long-life protection? Today, it is not uncommon for treated FR garments to be replaced every year.
- 2. Safety** – Can improvements be made to the level of protection, i.e., reduced burn percentages when exposed to fire, minimal thermal shrinkage, and high ARC flash protection?
- 3. Comfort** – Does the fabric feel good and protect? What about heat stress and moisture management? Workers today do not want to have to fight their clothing when working in challenging environments.
- 4. Confidence** – Is the garment going to provide the expected protection regardless of its age or care? Since fire is unpredictable, do you trust what your wearing is providing the best level of protection?
- 5. Appearance** – Can FR garments provide protection during the workday and also double for acceptable street clothes when the shift is over?

Springfield DH

Springfield DH is a patent-pending, dual-hazard fabric that protects against both flash fire and electric arc. It is designed to meet the changing expectations of the FR market. The development of Springfield DH began in 2004, when we started combining select fibers to achieve specific desirable characteristics detailed above. As multiple engineering iterations were evaluated, Springfield DH emerged as a new product designed to deliver an alternative to high-cost aramid products or chemically treated FR fabric with a short lifecycle.

Springfield DH is designed to provide a solution that bridges a vast number of industries and adheres to the most important performance standards. FR regulations, such as NFPA 70E, and NFPA 2112 specify the requirements that a fabric must meet in order to certify a garment to that specific standard. Under the General Duty Clause (Section 5 (a) (1)), OSHA states that each employer shall furnish employment free from recognized hazards likely to cause death or serious harm. As a means to adhere to this regulation, many industry standards have been established specifying the protection requirements for FR garments.

NPFA-2112 Standard on flame-resistant garment for protection of industrial personnel against flash fire.

- FR TEST REQUIREMENTS: Flame Manikin, Vertical Flammability, Heat Transfer Performance (HTP), Thermal Protective Performance (TPP), Thermal Shrinkage
- MAJOR INDUSTRIES: Petrochemical, Refineries, Chemical Manufacturing, Nuclear, Rail, Manufacturing
- KEY GARMENT FACTS:
 - > Single layer fabric applications
 - > Cost critical market
 - > Durability
 - > Hot environments
 - > Manual labor applications

CAN / CGSB 155.20 Standard on workwear for protection against hydrocarbon flash fire

- FR TEST REQUIREMENTS: Flame Manikin, Vertical Flammability, Heat Transfer Performance (HTP), Thermal Protective Performance (TPP), Thermal Shrinkage
- MAJOR INDUSTRIES: Petrochemical, Refineries, Chemical Manufacturing, Nuclear, Rail, Manufacturing
- KEY GARMENT FACTS:
 - > Single layer fabric applications
 - > Cost critical market
 - > Durability
 - > Hot environments
 - > Manual labor applications

NPFA-1977 – Standard on protective clothing for wildland fire fighting

- FR TEST REQUIREMENTS: Total Heat Loss (THL), Radiant Protective Performance (RPP), Vertical Flammability, Thermal Shrinkage
- MAJOR INDUSTRIES: Wildland Fire Fighting
- KEY GARMENT FACTS:
 - > Single-layer fabric applications
 - > Durability – Rugged use garment
 - > Hot environments
 - > Extreme manual labor applications
 - > Critical safety component during exposure to fire

NPFA-1975 – Standard on station / work uniforms for emergency services

- FR TEST REQUIREMENTS: Vertical Flammability, Thermal Shrinkage, Thermal Stability
- MAJOR INDUSTRIES: Fire Services
- KEY GARMENT FACTS:
 - > Single-layer fabric applications
 - > Not first-line protection in structural fires
 - > Hot environments
 - > Uniform appearance requirements
 - > Daily comfort

NFPA 70E / ASTM F1506 Standard performance specification for flame-resistant and arc-rated wearing apparel for use by electrical worker exposed to momentary electrical arc and related thermal hazards

- FR TEST REQUIREMENTS: Vertical Flammability, ARC Flash
- MAJOR INDUSTRIES: Electrical Utilities, Electrical Maintenance
- KEY GARMENT FACTS:
 - > Single to multi-layer fabric applications
 - > Arc-rated protection depending on job requirements
 - > Cost-critical market
 - > Manual labor applications
 - > Critical safety component during exposure to electrical ARC

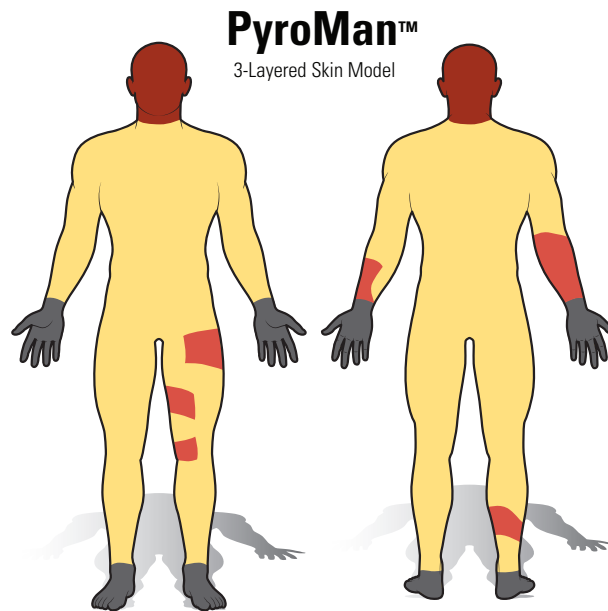
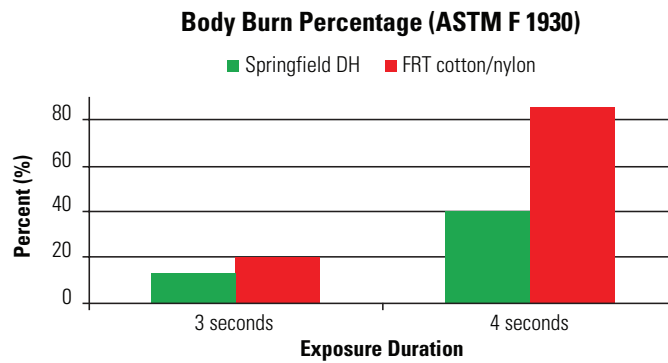
Springfield DH is designed with inherent FR properties; protection is built into the fiber. Normal laundry conditions will not adversely affect the performance of the garment, as is possible with FR treated garments exposed to certain chemicals. The fabric is designed to not melt, stick, or drip when exposed to extreme temperature or flame. Moreover, it is designed to withstand the rigorous wash conditions common in commercial or industrial laundries. As far as FR characteristics are concerned, there are no “life of the garment” limitations. If the garment is wearable, it affords FR protection to the wearer.

Under normal wear condition, garments made with Springfield DH fabric can provide years of dependable and reliable service. It is expected that garment life should be comparable to other inherent FR blended products and 2 times the expected life of FR treated cotton/nylon (FRT cotton/nylon) garments.

Springfield DH provides superior protection against flash fire hazards as demonstrated on the manikin (ASTM F 1930) test. The average burn percentage on the 7.5 oz. product is 13.5% at 3 second duration which includes the head at 6.6%. The chart (top right) shows how Springfield DH compares to treated FR cotton/nylon. At a similar, though 35% lower body burn result at 3 seconds, the true value of Springfield DH is evident

when the exposure time is increased. At 4 second exposure, the additional body burn more than doubles with Springfield DH providing a superior option when considering that fire is unpredictable and surviving a 4 second flash fire is much greater if you’re wearing a garment made from Springfield DH.

According the American Burn Association, mortality rate dramatically increases with age and percentage of body burn. (“Table 9 - Mortality rate by age group and burn size” American Burn Association, National Burn Repository, 2012). As illustrated in the following chart, the chance of survival is significantly improved when the body burn percentage is the lowest. This is especially true as age increases. According to the study, a 65 year old with 85% body burn has a zero percent chance of survival.



THERMAL PROTECTIVE CLOTHING ANALYSIS SYSTEM

Burn Injury Prediction

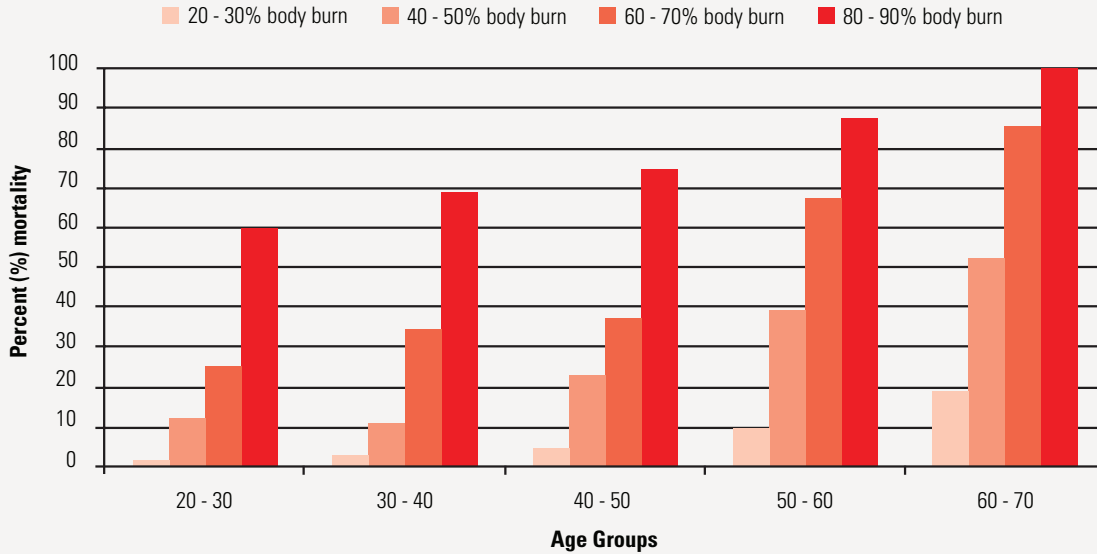
SPRINGFIELD, LLC

SPRINGFIELD DH 7.5 OSY/NAVY COVERALL/3 SEC, REP #2

Exposure Time (s): **3.00** DAQ Time (s): **60.00** Time Step (s): **0.50**
 % 2nd Degree Burns: **5.738** % 3rd Degree Burns: **6.557** % Total Burn: **12.30**

■ Invalid Sensor ■ No Burn ■ 2nd Degree Burn ■ 3rd Degree Burn

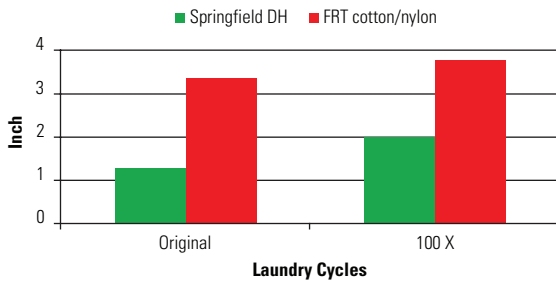
Mortality Rate by Age Group and Burn Size



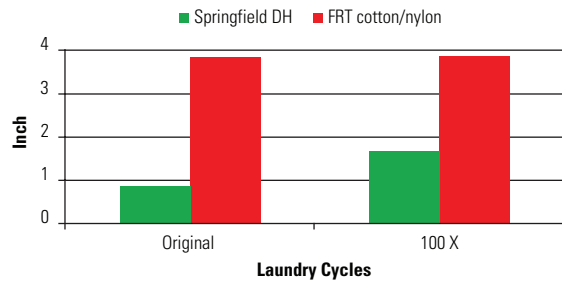
Springfield DH also provides superior performance in the following areas:

LOW CHAR LENGTH RESULTS – Springfield DH demonstrates less than 2” char length before wash and after 100 industrial laundry cycles in both the warp and fill directions. In addition to the low char results, the test samples demonstrated zero seconds after flame before or after repeated washings. As an added benefit, the fabric maintains significant structural integrity after flame or extreme heat exposure. This ensures the garments will not break open or suffer structural failure in the event of flame or high heat exposure.

Char Length - Warp (ASTM D 6413)

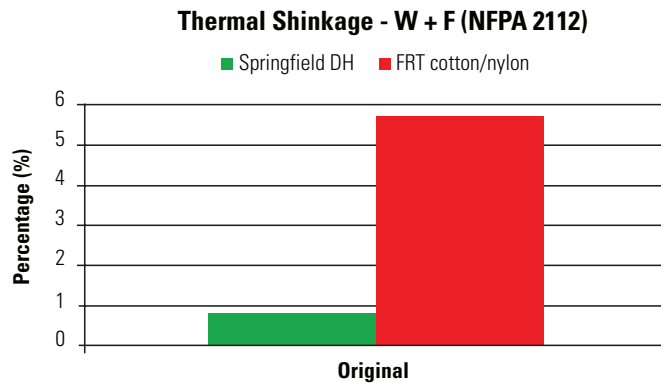


Char Length - Fill (ASTM D 6413)



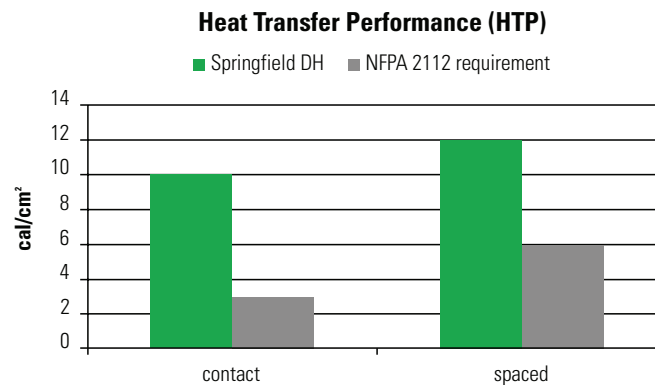
LOW THERMAL SHRINKAGE RESULTS

Springfield DH maintains less than 1% thermal shrinkage when exposed to 500° F for 5 minutes. This thermal stability performance is the same before and after laundering. The fiber blend combination of Springfield DH provides superior thermal shrinkage stability to the fabric, ensuring your sleeves and pants legs will not draw up during a fire, thus reducing the area of protective coverage.



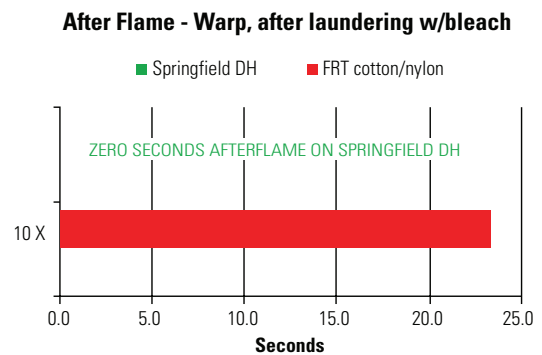
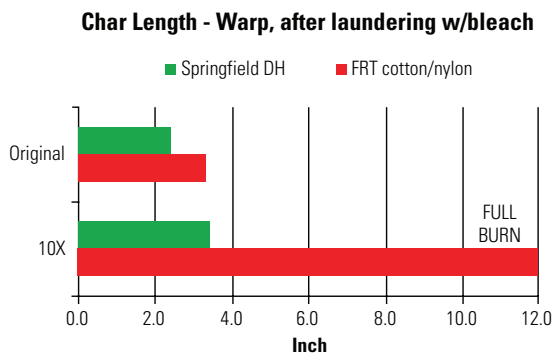
HIGH HEAT TRANSFER PERFORMANCE

(HTP) RATINGS – Springfield DH provides excellent protection from thermal exposure. The HTP performance is at least twice the specification requirement, thus providing excellent protection against second degree burns.

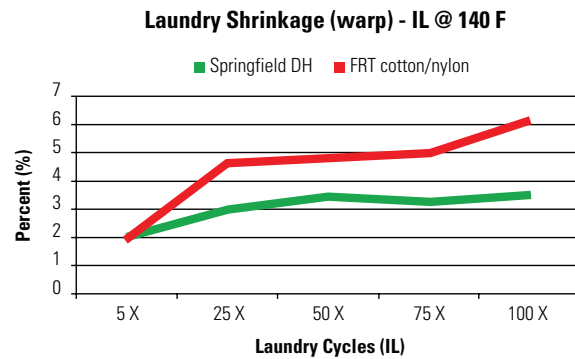
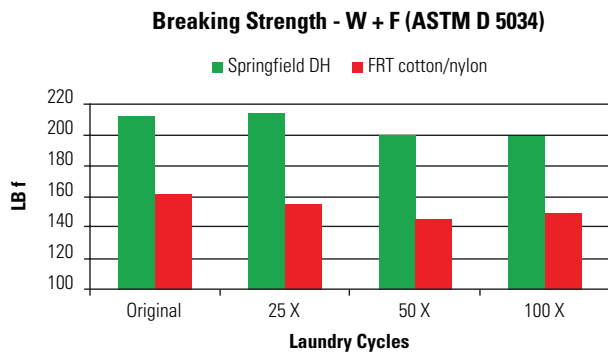


PERMANENT FR PERFORMANCE

Laundry care shouldn't be detrimental to your garment. Using standard industrial wash methods, Springfield DH continues to provide consistent and dependable protection. The following illustrations demonstrate what exposure to bleach can do to the FR properties of FR treated cotton/nylon products. Though bleach is not recommended in the care instructions for either fabric, catastrophic failure of the FR protection is guaranteed if FRT cotton/nylon products are exposed to bleach.



FABRIC STRENGTH AND STABILITY – Springfield DH maintains performance properties throughout repeated laundry cycles. The following charts illustrate how Springfield DH maintains strength and stability throughout 100 laundry cycles.



Springfield DH demonstrates several performance advantages over the compared FR treated cotton/nylon. Besides excellent wash and wear performance, the fabric has a low propensity for surface pilling due to its construction and finishing techniques. Union dye shades can be achieved with good colorfastness properties, an advantage over other blended fabrics. Hi-visibility shades are possible as specified by ANSI 107 and CAN Z96.

While demonstrating good initial fabric strength and abrasion resistance, Springfield DH retains significant strength and structural integrity following extreme thermal exposure. This is an important fabric characteristic, ensuring that the protective garment will remain intact if a flash fire or an ARC-flash incident occurs.

Springfield DH is designed to provide comfort with performance and a high level of aesthetics. Its natural feel is a result of a high percentage in the blend of Tencel®, a hydrophilic fiber that enhances comfort. Blending the Tencel® with hydrophobic fiber improves the moisture management and breathability of the fabric. The overall comfort of the fabric is achieved by the patent pending fiber blend and dyeing/finishing techniques developed at Springfield LLC. Not only does the fabric provide a high level of protection, it is also appropriate for everyday wear. This is a big advantage to workers who prefer not to carry a variety of clothing to the job site.

Summary

Springfield LLC started with a business plan to produce fabrics with worker safety in mind. The decision to enter into the FR market over 20 years ago was based on producing the best products possible that would provide the maximum protection to workers. All of the FR fabrics that Springfield manufactures are inherently FR. This ensures that every garment will provide the maximum protection through the lifecycle of the garment. Springfield DH is another fabric in the growing FR product line at Springfield.

Springfield is a vertical producer of uniform fabrics to the industry worldwide. The company, based in Jericho, New York, continues to expand product offerings into the Military, Fire Service, Protective Industrial, and Occupational markets. Springfield is the fastest-growing American manufacturer of flame-resistant fabrics. It makes all of its products in America using a quality-control system that meets the rigorous international standards of ISO 9000 certification. A substantial investment in

state-of-the-art technology and equipment has fueled Springfield's growth and yielded numerous innovations that raise the industry standard for FR performance.

About the Author

Quentin Bonner has been actively engaged in the textile industry since 1988. Quentin received his undergraduate engineering degree from West Virginia Institute of Technology and later his Master's Degree in Textile Engineering from the Institute of Textile Technology in Charlottesville, VA. He has spent his career in the textile trade working in manufacturing, technical management, and product development. Quentin is currently part of the Springfield product development team that has recently issued two U.S. patent applications for advancements in FR workwear innovation.

Contact

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