**FR clothing comfort increases protection and performance in fire fighting applications**

Protective clothing used by structural fire fighters has come a long, long way. Historically, fire fighters did not have the same level of clothing protection, performance and comfort that is used today. This is because most fires were fought from the outside of burning buildings, and structures were rarely entered.

Today, the level of protective clothing for fire fighters is set by standards such as NFPA 1971*®*: *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting®*, which specifies performance requirements for both structural fire fighting and proximity firefighting protective ensembles, ensemble elements, clothing, and equipment.

NFPA 1971 and similar standards in other countries require all turnout clothing must have three components: an outer shell, a moisture barrier, and a thermal barrier. In between these layers are pockets of air known as "dead zones." These layers of air, along with the three protective layers, help to further insulate the wearer from the extreme environments of fires. Usually turnout pants are outfitted with reinforced knees and leather cuffs.

Materials used for FR fire fighting garments vary. True North, for example, offers dozens of types of FR clothing for structural fire fighting in its DragonWear™ line, including outerwear, base layers, pants, shirts and headwear. A men’s fleece jacket is made from a combination of [Polartec® Nomex® IIIA Thermal FR®](http://www.truenorthgear.com/technology/polartec-nomex-iiia-thermal-fr). The jacket is lightweight, warm, breathable, wind-resistant, water-repellent and fire resistant. The permanent protection won't melt, drip, or support combustion in the air. It cannot be washed out or worn away.

These Polartec® FR products are not consider traditional “turnout” or “bunker” gear—the tough, hardened outer jackets and pants worn by fire fighters, says Mike Batson, Polartec® Global FR business manager. These FR products do meet NFPA Standard 1975®: *Standard on Station/Work Uniforms for Emergency Services*®, which sets requirements for the design, performance, testing, and certification of nonprimary protective station/work uniforms and the individual garments comprising station/work uniforms. They can be worn around the fire station when bunker gear is not required, and beneath bunker gear, says Mike, thus meeting NFPA standards 70E, 1977, 2112 and 1951.

**Injuries and fatalities**

The nation’s fire fighters need this “trifecta” of protection, performance and comfort, as True North owner Alyx Fier calls it. An estimated 81,070 fire fighter injuries occur annually in the United States. Forty-nine percent of fire fighter injuries occur on the fire ground and six percent occur while responding to or returning from a fire incident. Overexertion/strain is the leading cause of fire-related fire fighter injuries at 25 percent.

The National Fire Protection Association (NFPA) estimated there were 30,125 fire departments in the United States in 2010. These fire departments are staffed by approximately 1,190,000 personnel. There were a total of 1,044,300 active career, volunteer, and paid per call fire fighters representing nearly 88 percent of the registered departments' personnel.

The U. S. Fire Administration (USFA) has tracked the number of fire fighter fatalities and conducted an annual analysis for 36 years. Twenty-two firefighters were killed during fire ground operations in 2012. In 2010, there were 2.33 firefighter fatalities per 100,000 fire incidents in the United States. Almost half (47.2 percent) died of heart attacks, with trauma accounting for 28.2 percent of deaths and asphyxiation 6.4 percent.

Between 1977 and 2012, 4,410 on-duty fire fighter fatalities occurred in the United States.

**A lengthy list of hazards**

Hazards faced by fire fighters compose a lengthy list. They include: 1) biological – exposure to contagious and infectious diseases such as AIDS and hepatitis B and C; 2) chemical – exposures to carbon monoxide, hydrogen cyanide, nitrogen dioxide and many other chemicals; 3) ergonomic – overexertion (reaching, carrying, etc.), walking or working on feet for long periods of time, and lifting; 4) physical – heat stress is common, coming from sources including the fire and surroundings, and also produced by the body during work (exercise) that can be compounded by the heavy equipment being carried; 5) safety – the fire itself, burns, radiant heat, structures breaking apart, unstable floors, falling objects, sudden ignition of products creating flashover, and backdraft, where air is introduced to an area that is superheated and oxygen-starved; and 6) psychological – exposure to graven or uncertain dangers, intense stress, traumatic events, and shift work or extended work days.

**NFPA standards**

Numerous NFPA standards apply to the fire industry:

**● NFPA 1971***®***:** *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting* *®*

**● NFPA 1851***®***:** *Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting®*.

**● NFPA 1951***®***:** *Standard on Protective Ensembles for Technical Rescue Incidents®*

**● NFPA 1977***®***:** *Standard on Protective Clothing and Equipment for Wildland Fire Fighting*®.

**Challenges of wildland fire fighting**

Wildland fire fighting is a dangerous occupation. In the past 10 years, more than 200 fire fighters have died while participating in wildland fire suppression activities, according to the U.S. Fire Administration.

In 2010, there were approximately 34,000 federal workers employed in wildland fire suppression activities and an unknown number of volunteer wildland fire fighters, according to the National Institute for Occupational Safety and Health (NIOSH).

Challenging conditions are encountered when responding to a wildland fire (rapid response, poor visibility, uncharacterized hazards, unfamiliarity with the environment, etc.). This is in addition to the hazards also faced by structural firefighters: heat stress; fatigue (physical and mental); injuries (burns, sunburns, slips, trips and falls, scrapes and cuts, struck by partially burned trees and ATVs, electrocution from downed power lines, snake and animal bites, exposure to poison ivy, thorns, etc,); respiratory hazards from smoke, ash and debris; and cardiac-related events such as heart attacks and strokes.

**FR garments seldom fail**

Very few of the fire fighter injuries reported to the National Fire Incident Reporting System (NFIRS) indicate problems with fire fighter protective gear—only nine percent indicate protective gear failures as a factor in the injury. Modern equipment and equipment standards, combined with current equipment replacement cycles, can preclude protective equipment failures. Fire fighter gloves with wristlets, positive pressure self-contained breathing apparatus (SCBA), and hoods account for 32 percent of equipment problems, according to the NFRIS.

True North President Steve Misiano can tell you one reason for the relative lack of equipment failures: wear trials.

“Having a group of end users to get real world testing and to get feedback – how does it work in the field, how does it hold up – this is critical to our garment development. I find fire fighters who work in these garments want to know that the clothing is going to protect them, that it meets standards, and then it comes down to comfort and fit. ‘Do I want to wear this while working? Does it fit me?’ Most fire fighters are very comfortable in voicing their opinions to us. They’re straightforward.”

In the 10+ years Polartec® has marketed FR garments, Mike Batson says fabric weight has been reduced and durability has improved, along with enhancements to comfort factors. He says a recent trend is the blending of fibers. Polartec® in some new FR garments uses both FR and non-FR fibers to get the best features of comfort and FR. The knit fleece can consist of fibers that take moisture off the skin, and fibers on outer surfaces that don’t transport moisture, allowing it to evaporate. Mike calls this an engineered “push and pull effect,” where moisture is pulled off of the skin and pushed to the outer surface to evaporate.