

when  
**SECONDS**  
count

IMPACT'S UNDERGARMENT RECOMMENDATIONS  
FOR DRIVERS & CREW



Impact Undergarment Recommendations Rev.2014a (3.27.14)

# when **SECONDS** count

An SFI 3.2A/5 rated fire suit is required to provide ten (10) seconds of protection against a second-degree burn. *Ten Seconds.*

We would venture to guess it takes longer to read this paragraph. For this reason, Impact recommends the use of additional fire protection such as SFI 3.3 rated Nomex® (or other aramid fiber blends) undergarments for all drivers and crewmembers.



## Not All Undergarments Are the Same

Petroleum based and other synthetic blends of undergarments, such as the athletic or compression style close-fit garments (commonly used for their cooling, moisture wicking, and quick drying features), have been gaining in popularity. Unfortunately, the same materials that provide these undergarments with their desired features also pose an extreme burn risk. Synthetic fibers such as Nylon, Elastane, or Polyester melt when ignited. Synthetic blends react to flame in a similar manner as a candle does when its wick is ignited. Just as a candle's wax melts and drips when exposed to flame, so do the materials that are used in many of the athletic style undergarments found on the market today. While this type of apparel may be ideally suited for a wide range of sports activities, these garments are extremely dangerous on pit row where fire hazards exist.

The burn hazard risk from synthetic garments has even caught the attention of the United States armed forces, to the point that the Marines have banned the use of garments containing synthetic fibers for nearly a decade.

The below link demonstrates the United States Marines position on synthetic undergarments and the burn risk such apparel poses:

<http://www.defense.gov/News/NewsArticle.aspx?ID=15478>



**SFI COMPLIANT  
SPEC 3.3**

## So What Do the Various SFI Ratings Mean?

The SFI Foundation's Specification 3.2A tests a garment's fire retardant capabilities and also details specific garment construction and performance characteristics. The SFI specification contains a rating system based on the garment's ability to provide Thermal Protective Performance (TPP) in the presence of both direct flame and radiant heat. The purpose of the TPP is to measure the length of time the person wearing the garment can be exposed to a heat source before incurring a second degree, or skin blistering burn.

There are various sub categories (which refer to the garment's TPP ratings known as "Thermal Protective Performance") for the 3.2A specification. The TPP rating is the product of exposure heat flux and exposure time. The TPP results can be converted to the time before a second-degree burn occurs. The higher the garment rating, the more time before a second-degree burn.

SFI Rating	TPP Value	Time to 2nd Degree Burn
3.2A/1	TPP 6	3 Seconds
3.2A/3	TPP 14	7 Seconds
3.2A/5	TPP 19	10 Seconds
3.2A/10	TPP 38	19 Seconds
3.2A/15	TPP 60	30 Seconds
3.2A/20	TPP 80	40 Seconds

You may have noticed an SFI Manufacturer's Certification tag with an alphanumeric identification number on your suit or SFI rated undergarments. The above graph outlines the TPP level and the corresponding SFI rating, in addition to the expected time until a second-degree burn. A driving suit with an SFI specification label 3.2A/1 will most likely be a single-layer suit and is frequently only accepted in the entry-level and grassroots racing organizations as it provides only minimal protection against direct flame and heat transfer. The most commonly required specification by stock car racing sanctions is an SFI 3.2A/5 rated suit which, as noted above by the SFI TPP value specification, offers an estimated additional seven seconds of protection (versus an SFI 3.2A/1 rated suit) until a second degree burn is likely to occur for a total of ten seconds of protection.



Nitro and Alcohol powered drag racers require greatly increased TPP values for fire retardant garments. While nitromethane burns more slowly than gasoline, the volume of fuel that can be pushed through the cylinders is much greater, creating more power from each explosion and resulting in the higher horsepower and extreme speeds these racecars are known for. When you see flames shooting out the exhaust pipes of a Top Fuel dragster, this is because not all of the fuel was burned off between the spark plug firing and the exhaust valve opening. The engine is essentially pushing still-burning fuel into the exhaust.

Because of how these fuel mixtures react under these unique circumstances, suits and other fire retardant garments constructed for use in nitro and alcohol fueled drag applications must be constructed from greatly increased layers of Nomex® and meet much more stringent TPP requirements. The SFI ratings designated for these applications (depending on class and fuel) are 3.2A/15 and 3.2A/20. Suits meeting these standards offer between 30 and 40 seconds of thermal protection against second-degree burn and reflect a TPP values ranging between 60 and 80.

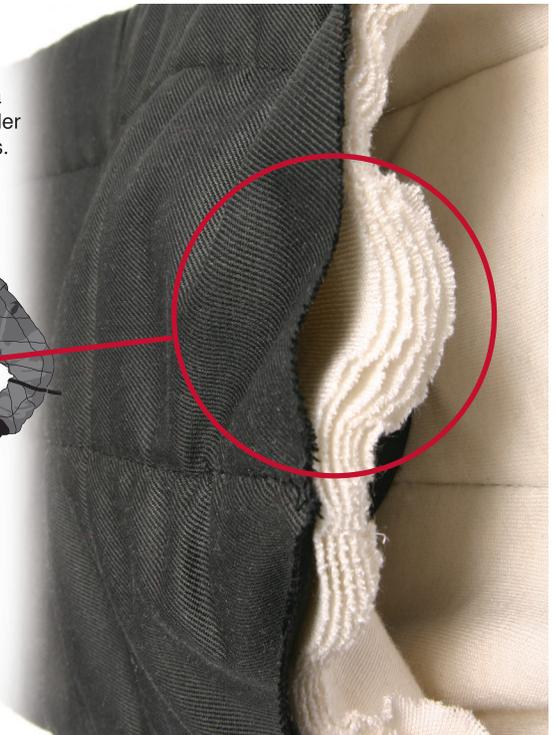
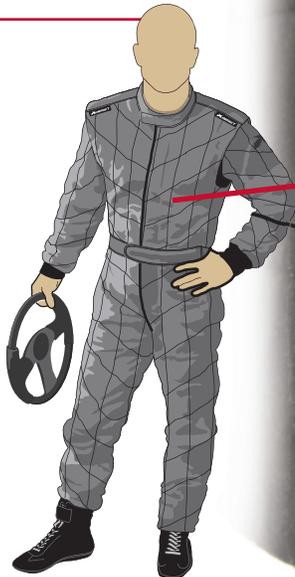


Whether you are in the heat of the battle and setting up your car for the next turn or fueling a driver coming into a pit, a fire can happen when you least expect it. Your driving or crew suit may be the first line of protection against heat transfer and flame, however as shown in the SFI TPP and Second Degree Burn Graph, the typical two layer fire suit only provides about ten seconds of protection against a second degree burn. While this amount of time may seem like forever when you are in the “heat of the moment”, fluid soaked suits can become sweltering. Fire retardant undergarments are a second line of defense, providing an additional layer of insulation against direct flame and thermal transfer and also providing valuable additional seconds of time. Impact highly recommends the use of fire retardant undergarments including balaclavas, socks, and long sleeve shirts and pants, even if your sanctioning body does not require these items.

One of the most effective ways to enhance personal safety on the track or in the pits is to increase the number of Nomex® layers your suit is manufactured from. A two or three layer suit is far more resistant to flame and heat transfer and will provide you with valuable additional seconds of time during an emergency situation versus a single-layer suit. Additional protection can also be obtained by wearing Nomex® undergarments beneath the driving or crew suit as well as a balaclava and Nomex® socks.

## Suit Quilting

Quilting has long been thought of as an aesthetic suit design element, so much so that art renderings often indicate complimentary or off-setting quilting to stand out and match sponsor's colors. In reality, quilting serves a very important function in the construction of a suit. In addition to marrying the multiple layers of Nomex® together, quilting also improves air circulation and transfers heat at a slower rate and with less force and energy. The air pockets created between the quilting and the multiple layers of Nomex® provide valuable thermal barriers and delay heat from being transferred to the body as quickly. Quilting is such an integral element to delaying heat transfer that the FIA has included this functional design element into their specification. Per the FIA specification: “Continuous filament for the outermost layer of the outer garment shall be quilted diagonal/cross or vertical/horizontal with a maximum distance of 10 cm between the stitches. It is permissible to omit the topstitching in the immediate vicinity of the embroidery.”



The same theory and functional design element regarding suit quilting also applies to fire retardant undergarments. The air pocket layer between a suit and an undergarment creates an additional thermal barrier thus delaying heat transfer from occurring. Think of heat transfer in terms of sunburn or even sitting around a campfire and feeling the heat permeating the skin the longer you are out in the sun or the closer you sit to the campfire. While your skin may not be in direct contact with the campfire or the fiery star for which we make a yearly revolution around, the effects of the emitted heat can have devastating consequences on our epidermis. Barriers, such as the air pockets created by layering fire retardant garments or through suit quilting, can provide valuable seconds of protection.

## Additional Precautions

In addition to wearing the proper fire retardant garments, one of the most overlooked and easily correctable precautions to personal safety is to ensure that all watches, jewelry, and other metals are removed prior to working around fire hazards. Metal has high thermal conductivity and will burn the skin in as little as five seconds with a surface temperature as low as 48° Celsius (118° F). Just as a hot brand leaves a permanent mark on livestock, the metals contained in watches and other jewelry can also leave a painful brand when exposed to heat and flame. For this reason, Impact highly recommends that all metals and other potentially harmful objects be removed while in the pit box or working around flammable materials.

The chart below demonstrates the various temperatures skin begins to burn and degrade in the presence of heat or direct flame. As noted below, human skin begins to completely degrade in temperatures as little as 72° Celsius (162° F). Considering the typical candle flame is 600° - 1,000° C (1100° - 1,800° F) and the average smoldering cigarette is 510°-600° C (950° - 1100° F), it is easy to imagine the extreme conditions that would be present from a pit fire and why the proper apparel and precautions are necessary.

°C	°F	Response
37	98.6	Normal Human Oral/Body Temperature
44	111	Human Skin Begins to Feel Pain
48	118	Human Skin Receives First Degree Burn Injury
55	131	Human Skin Receives Second Degree Burn Injury
62	140	A Phase Where Burned Human Tissue Becomes Numb
72	162	Human Skin is Instantly Destroyed



## Complications from Fire and Burns

According to the Centers for Disease Control (CDC), deaths from fires and burns are the third leading cause of fatal home injury (Runyan 2004). The United State's mortality rate from fires ranks eighth among the 25 developed countries for which statistics are available (International Association for the Study of Insurance Economics 2009). While medical advances have greatly increased the chance of survival for individuals with severe burns, the road to recovery is a long and painful process. In the weeks following a severe burn, infection and risk of shock are the immediate threats to survival. Unfathomable pain from the burn itself, the daily wound dressing changes, and the skin grafting process are realities of life for victims of fire. Even after recovery, burn victims have difficulty in the affected areas as the scar tissue often lacks elasticity and can impair mobility.

## In Summary

Synthetic undergarments provide cooling comfort and moisture wicking properties however the consequences of wearing these garments on pit row (or while in a race vehicle) can have devastating consequences. You wouldn't drive a car without a seat belt or strap into a racecar without a helmet. Just like accidents, fires can happen when least expected. Preparing for the worst and providing yourself with valuable extra seconds of protection can be as simple as wearing a few additional items of fire retardant gear. Drivers and crew should also take additional precautions by removing watches, jewelry, and other metal objects that could potentially cause painful burns through thermal exposure.

Ernest Hemingway may have said it best when he remarked, "Auto racing, bull fighting, and mountain climbing are the only real sports... all the others are games." It's no secret that motorsports are inherently dangerous. In racing, the unfortunate reality is that incidents such as fire are not a matter of "if" but rather, "when." Having a plan and the proper gear for dealing with unforeseen circumstances can greatly increase the chances for a better than expected outcome and reduce the potential for injury or worse. Make sure your crew is "up to speed" and utilizes the best safety practices!

*"The crashes people remember,  
but drivers remember the near misses."  
- Mario Andretti*



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