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The King Has a New Set of Clothes

Probably everyone remembers the fairy tale about the king having a new set of clothes. As you will probably recall in that fairy tale, a con man came into a kingdom and convinced a very vain king that he had developed a “special” type of material that only royalty could see. The con man, using his invisible material, convinced the king that he was developing a new type of clothing fit only for royalty, and that the common people would never be able to understand it or see it.

As you will also recall as the story developed, the king, eventually putting on his new raiment, decided to parade down the city streets. The invisible clothing, which the king was supposed to be able to see, resulted in his making his sojourn practically in the nude. Only when a small child spoke up did he finally realize that he had been duped. The king had no new clothes despite the fact that he had been led to believe that his body was covered with the finest of vestments due his rank and authority in society.

To a certain degree, we are beginning to believe the same kind of myth in the fire service when it comes to protective clothing. Now don't get me wrong. I happen to believe that it is extremely critical that we develop an adequate level of protection for our firefighters through research and development into both materials and methodologies to reduce injuries and fatalities.

What worries me about all of this is the firefighter's attitude and the approach that we are beginning to take toward protective clothing. Many firefighters are beginning to believe that protective clothing is there to create a “suit of armor” effect that allows them to penetrate the bowels of the most foul and inhospitable fire environment that is conceivable. Nothing can be further from the truth. The purpose of protective clothing is to provide an adequate level of protection so that a firefighter can function safely without endangering his or her life.

Let me see if I can give you an example of what I am talking about as far as the firefighter's attitude. Several years ago, when we started coming out with some of our new “miracle materials” to increase the fire resistiveness of protective clothing, firefighters were told that these new materials would take extremely high temperatures. The quest for a material that would take the highest of temperatures began. Protective clothing in the minds of many become touted as the first line of defense against heat and the other elements in firefighting.

Right after that, a myth began to build. I served as a safety officer on a flammable liquids fire control school. While standing in the control tower observing the various teams approaching the props, I noticed that one crew, obviously outfitted in brand spanking new turnouts, was exhibiting some rather strange behavior. This particular crew was about to go up against a very large LPG prop. We had jokingly nicknamed this prop the Red Adair. What bothered me as a safety officer was as I observed the crew



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moving in on the prop, their lines were not only opened up and discharging water, but the crew commander was obviously taking the crew in very close to the fireball. The fire officer, in the center of the wedge, had his two crewmembers by the shoulders of their bright yellow turnout coats and was literally tugging the men closer and closer to the fireball. The firefighters could be seen to visibly wince and turning their helmets inward and downward, they appeared to be shrinking down to the ground from the radiant heat.

Blowing my whistle as the safety officer, I shut down the fire line, left the tower and went to talk to the officer. This particular individual was visibly irritated with me because I had shut down his “demonstration.” When I asked him what he was attempting to prove by taking the crew in that close, his explanation was this: “We got these new turnout coats and they will take up to 800 degrees, including direct flame impingement. I was showing my crew just how much punishment these coats would take.”

Punishment! In fact, crewmembers were taking the punishment. One of the firefighters, taking off his turnout coat, revealed blisters on his left forearm. This was from the radiant heat flux being transferred through the turnout coat. Another of the firefighters revealed that the wet leather gloves that he was wearing at the time had literally steamed the back of his palms as he had approached the fireball. Granted, those brand spanking new coats made of the finest materials and sewn with the greatest of care were still intact, but what about the human being inside of them.

Therein lies the problem that we are beginning to create in the fire service by failing to realize the human factors in the engineering of protective clothing. The real issue is this: How can we best protect the firefighter without overprotecting him and endangering his life?

If that statement sounds contradictory, then perhaps we should start looking very carefully at the concept of personal protection. There is a distinct difference between the safest way to fight a fire and the most effective way to fight a fire. I have often said that the safest way to fight a fire is to go in wearing a swimming suit. Then, you fully are aware of what your limitations are and you will not do anything stupid enough to endanger the various layers of epidermis that protect you. On the other hand, that is not an effective way of combating fire, because it does not allow you to penetrate into a firefighting situation far enough to be able to get to the seat of the problem. Where is the balance?

I believe that it is totally possible to design protective clothing for a firefighter that will allow him to penetrate so far into a hostile environment that once something in that system fails, i.e., the weakest link, then the protective clothing may survive the emergency, but the firefighter won't. What we are looking at here is basically the issue of the indestructibility of the system. Protective clothing can be made indestructible, but the human body has very definite limitations to it. The body is a “finite” sink against toxic and traumatic insult.



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During my research in the field of protective clothing, I came across a study that is done for the United States Air Force regarding pain thresholds after being exposed to various levels of heat. This study, "Pain Time Versus Fabric Ignition for Exposure to Flame," was conducted by Factory Mutual in 1971.

Now many of you have heard the old cliché that a firefighter's ears should be open so that he can "feel" the heat. What this mythological thermometric system has resulted in is large numbers of career and volunteer firefighters with huge blisters and calluses on the tops of their ears. It is a physiological fact of life that the human body's pain threshold does not recognize rapid rises of heat until it has, exceeded the temperature to burn the outer layer of skin. A person is, therefore, burned before they realize the danger.

In other words, by allowing a firefighter's body to be open to the heat, the only thing that that proves is that he will know ultimately that he has been burned and that there is no way that the human body is capable of determining exactly what that heat level is. In one of the experiments I conducted during the STAR Team project, we taped a mechanism to firefighter's helmets called "tempu-tabs." These are chemical tabs that are sensitive to various heat levels down to the point where they can distinguish between temperature rises of ten to fifteen degrees. Firefighters were asked to enter various levels of stratified and unstratified fire environments and then asked to assess what the temperature levels were when they came back to the outside. These were "real time" fire behavior scenarios.

In order to verify and validate our observations, thermocouples had been installed in the buildings at various heights in the fire area and these were being documented at the same time firefighters were in the building.

Without belaboring all the details of the experiment, it was noted that most of the firefighters were anywhere from 250 to 350 degrees off in their assessment of how "hot it was in the structure." The direction that the firefighters were off was in drastically overestimating how hot it was. In other words, the firefighters would come out and ask how much heat they had just experienced, and they would make statements like 350, 450 or 500 degrees. By looking at the range of tempu-tabs that were on their helmets, we would be able to determine, that in most cases, they were experiencing heat ranges of 180 to 225 degrees. Why no higher? Because they were not able to allow themselves to go into heat temperatures over those without suffering very, very severe burn damage.

The thermocouples in the area showed ceiling temperatures, in some cases, in excess of 1,000 degrees with the thermal balance bringing the heat levels all the way down to the floor to 110, 120, 150 degrees.

What's to be learned about protective clothing in the context of this kind of experimentation? Well, for one thing, it is hotter than hell on the inside of a burning building! The second thing is that your



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protective clothing will allow you to function in one arena or domain of that fire, but in no way does it imply that you will be able to survive in the other domain.

After assessing this particular phenomenon, the question begins to arise, what should we be doing in the field of protective clothing? For one thing, it makes no sense for us to go back to the beginning of history and discard all the research and development that has gone into the development of our current protective clothing. The materials that we have developed are excellent, but they have their limitations, too. The focus, however, on protective clothing must begin to take into consideration the training and knowledge level of the firefighters who are expected to function in that protective clothing.

I have often found it interesting that many of the projects that have been instituted to evaluate protective clothing, especially by members of the professional firefighter's unions and other fire service professional organizations, have devoted hundreds of thousands of dollars toward finding the perfect fire resistive material, and at the same time, these same organizations had devoted little, if any, emphasis on making sure that the entry level firefighter and even the journeyman firefighter has been adequately trained on fire behavior and fire ground survival techniques.

I am not talking about the proverbial class on the fire triangle, nor am I talking about the fifteen-minute lecture on safety that is sometimes passed off in recruit training as being like motherhood and apple pie. What I am talking about is a concentrated effort to "fire proof" the firefighters themselves. There is an amazing amount of resistance in the lower levels of the fire service. (When I use the term lower level, I am referring to rank hierarchy and not level of competency.) The idea is that firefighters have to have certification and meet minimum standards of training.

Many of the individuals who will berate and ridicule the protective clothing industry are not providing them with an adequate level of clothing, will think absolutely nothing of, in the same breath, attacking mandatory physical requirements, required certifications, and minimum standards for firefighters to conform to if they are going to be operating on the inside of burning structures. There is a tremendous resistance to disciplinary action against a person that fails to provide for their own protection.

That's hypocritical! It is unprofessional and contradictory. But the fact of the matter is that both of those areas are at issue in the fire service right at the time that this particular article is being prepared.

To continue with my observations on what can be done to improve the situation, it is important for the fire profession to begin to place into context the entire idea of fire ground survival. PROTECTIVE CLOTHING IS NOT THE FIRST LINE OF DEFENSE AGAINST A HOSTILE FIREFIGHTING ENVIRONMENT...IT IS THE FINAL LINE OF DEFENSE! IT IS THERE TO ALLOW THE FIREFIGHTER TO SURVIVE WHEN EVERYTHING ELSE FALLS APART.



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I find it particularly interesting when I read articles about individuals who are badly burned while wearing some of the most modern and up to date protective clothing. How come? I know of several cases where firefighters have criticized their fire helmets because they have “melted” when they stood up in an almost total flashover condition. The firefighters were forced back down to the ground level by the intense pain generated by the temperatures that deformed the helmets.

For example, in a recent fire service publication there was a photograph of a bunch of firefighters on an emergency. Where do you think their chinstraps were? There they were, all wrapped up around the back brim, looking macho, but damned ineffective to keep the helmets on their heads. Another article attacked turnout boots that “failed” in a hazardous materials spill. The boots were never designed for that task. They did not “fail”; they were forced to disintegrate because they were improperly used.

The question is, did the protective clothing fail? Did the training system fail? If a piece of equipment is totally destroyed in the process of preventing the human body from being damaged, has it failed?

Perhaps it is time for the fire profession to take a long hard look at the question of personal safety on the fire ground and focus in on the issue of the total system. I know that there are some who believe that the ensemble and “protective envelope” concept that has been discussed in Project Fires is the ultimate solution, but that system does not include the human element either. Protective clothing is not unlike the proverbial chink in a suit of armor. Any of the weaknesses that exist in this system can rapidly deteriorate a protective clothing ensemble into a cocoon of death.

There are many other considerations regarding fire ground safety. These include effective fire ground command and control procedures, effective pre-fire planning programs, coupled with operations and procedures aimed at improving safety under emergency conditions which are just as important as that protective clothing. Discipline is a two-way street that requires a “learned” response and action to fire scenarios, and it should include punishment for failing to use equipment or engaging in unsafe acts.

Recently, I had an opportunity to view a tape where a couple of fire officers allowed themselves to operate in a flammable liquid firefighting situation where the fire trapped them in the midst of a pool of burning liquid. Fortunately, their injuries were not serious, but the scenario is one that unfolds at many emergencies. If a firefighter is led to believe that he is totally protected by a sheet of material between him and a fire, he tends to go into situations that are unsafe and untenable if that system fails.

While a statistical database does probably not exist to justify the following statement, I have an intuitive feeling that the number of injuries to firefighters has not significantly decreased since the advent of some of our new protective clothing concepts. Granted, there are cases in which individuals have probably survived in spite of themselves. I can personally recall one individual who violated every safety rule in the book for administering a control burn and was badly burned as a result. Instead of focusing



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on the issue of proper administration of control burns, the entire argument focused on whether or not his protective clothing protected him.

Yes, the king does have a new set of clothes. But not unlike the kind of the mythological fairy tale, it is possible that we are looking but not seeing. Each and every firefighter should ask himself the basic question: How can I best be protected?

To recoin an old phrase that was given to me once in a hazardous materials workshop, it is not what you don't know that will hurt you, it is what you know for damn sure that ain't so that will reach up and grab you.