

The History of PPE

From the 2008 personal protective equipment e-Newsletter, reprinted with permission by Bobby Halton, Fire Engineering.

I Firefighting is a dangerous profession that requires specialized equipment to effectively and safely mitigate a fire emergency. An important part of this equipment is the firefighter's personal protective equipment (PPE): coat, pants, hood, helmet, boots, gloves, breathing apparatus, and personal alert safety system (PASS) device. The personal protective equipment structural firefighters wear today is drastically different than what they wore in the early years. Unfortunately, there isn't a lot of good and accurate information documented about the history of PPE, but some theories of yesteryear and modern day requirements have helped me to piece together how a firefighter's ensemble came to be.

Early Years

We can look back at American history and see that fire was present in our country's first colonies. In the 1600s, firefighters had to deal with the fire, heat, and smoke without modern technology. Structures often burned to the ground because firefighters fought the fires from the outside. Interior operations were not possible because the everyday clothing firefighters wore offered insufficient protection from heat and flames.

As firefighting evolved, so did the equipment firefighters wore. Jacobus Turck, the "caretaker" of New York City's two then-new Newsham hand pumpers, is credited with inventing the first fire helmet in the 1730s. It was leather, with a high crown and wide brim. Years later in 1836, Henry T. Gratacap designed a helmet similar to the one we use today, referred to as the "traditional" fire helmet. The design was a reinforced dome-shaped leather helmet with a front shield and brim rolling to a long back

tail. Finally the firefighter's head was awarded some protection from falling materials and water that ran off the back of the helmet. Some old images also show firefighters holding the helmets in front of their faces as they battle wind or intense heat from a fire.

Around the same time Gratacap was producing the fire helmet of the future, the firefighter's uniform also took a step forward. Wool, a heavy material that gave some protection against hot and cold environments, was used. Firefighters' pants and a long trench coat with a stiff collar were made of wool. Under the coat, firefighters wore a cotton or wool shirt that was usually red in color. To finish off the uniform, they wore leather boots.²

As rubber development progressed, it played a beneficial role in firefighter clothing. Rubber slickers worn over the wool coats added another layer of protection from the heat and most definitely kept the wearer dry. Boots made of rubber also kept the wearer's feet dry. Some archived history of the Huron (OH) Fire Division also confirms the use of rubber boots purchased for \$10 and rubber raincoats purchased for \$12 in the mid 1930s.

Also in the early years, respiratory protection for firefighters was minimal. Tales are told of firemen growing beards, soaking them in water, biting the beards, and breathing through them when in a smoke-filled environment. The beard may have acted as a filter, but they would still get choked up by the fire's by-products.

It wasn't until 1825 Italian scientist Giovanni Aldini attempted to design a mask to provide heat protection and fresh air. The concept spurred many more attempts to make a device that would be more effective.

A miner named John Roberts invented a filter mask that was widely used in Europe and the United States. During the same time period, several attempts were made to invent a helmet with a hose attached to a pump that supplied fresh air.

The first self-contained breathing apparatus came in 1863, when James Braidwood put two canvas bags together lined with rubber. The airtight sac was worn on the firefighter's back and secured with shoulder straps and a waist belt. Two rubber hoses connected to a mouthpiece allowed the wearer to inhale fresh air. Different size sacs were filled with air by a set of bellows and sealed with corks until needed. Firefighters also wore goggles, a leather hood, a nose clamp, and a whistle to complete Braidwood's invention.

Bunker Gear/Turnout Gear

As the firefighter's personal protective equipment continued to develop, the terms "bunker gear" and "turnout gear" became part of history. After speaking at length with fire history curator David Lewis, I can put forth several theories as to the terms' origins. In the mid 1800s, "bunking" was the practice of sleeping at New York City's volunteer firehouses, so the firefighter's "bunking gear" would be the clothing he would wear when responding or "turning out" to a fire during nighttime hours. Another theory about "bunker pants" comes from soldiers responsible for firing cannons from the built-up bunkers of World War I who wore padded pants. These pants protected their legs from shrapnel, water, mud, and hot shell casings flying around and in these bunkers. After the war, the soldiers often became firefighters

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Occupant Protection Concerns?

Seatbelts Are Not Enough!

While vitally important, seatbelts are only the starting point of a comprehensive approach to ambulance occupant safety, not the end result. To suggest they are adequate protection creates a very false sense of security. Crash tests, in fact, show a fully restrained occupant, even with a five-point seat belt, is in danger from headstrikes to the cabinets and cushions. The headstrike data recorded in instrumented testing programs is alarming—far above the recognized indexes for fatal incidents.

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and adopted the protective pants as part of their new uniform, according to Lewis.

Further Development

During and after the World Wars, steady progress was being made in the development of firefighting personal protective equipment. Long rubber trench coats, long rubber boots, and the traditional fire helmet were commonly seen. The long rubber boots were often referred to as three-quarter boots and covered the firefighter's leg to above the knee (photo 1).



(1) Note the three-quarter boots and long trench coat. [Photo courtesy of Huron (OH) Fire Division.]

It wasn't until after World War II when standards for firefighter personal protective equipment were developed. Several organizations began performance testing and creating standards for the equipment. The frontrunner in this endeavor was the National Fire Protection Association (NFPA), which still develops standards for protective clothing today (NFPA 1971, Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting).

The committee at the time wanted to see a firefighting coat with three layers: an outer shell that was flame resistant and would withstand temperatures of 500°F for about five minutes, a middle layer that prevented water from soaking the wearer, and an inner layer that protected against the three heat transfer methods (convection, conduction, and radiation). Other standards addressed the protective equipment dealing with the firefighters' hands and feet. Resistance to heat and resistance to puncture were two

important parts of the standard. Specifically, a steel shank and toe were required in the leather or rubber boots.

Also after World War II, Scott Aviation made breathing equipment for crews working in airplanes at high altitudes. The engineers noticed that the firefighters were still using filter masks and rebreathers that didn't provide adequate breathing air. Similar concepts were applied to the Scott Air-Pack, introduced in 1945.

I interviewed one of the most seasoned veterans of the Huron Fire Division to understand the specific protective equipment that was worn in the late 1970s. Firefighter Steve Dircks explained to me that when he started with the department in 1978, he was issued a vinyl silver long coat, three-quarter rubber boots, orange rubber gloves, and a plastic fire helmet resembling the material used in modern day construction hard hats. This entire ensemble was purchased for \$190. Dircks remembered that it wasn't until 1984 when new turnout gear was issued, consisting of pants with suspenders and a coat of black cotton material (photo 2).

It wasn't until 1982 that the NFPA developed a standard for personal alert safety system (PASS) devices. These devices send out an audible alarm when a firefighter remains motionless or is running out of air. Also in the 1980s, advanced fire-resistant materials such as Nomex® and Kevlar® were used to make the outer shell of the coats and pants.

Today and Tomorrow

The firefighting personal protective equipment in use today consists of a combination of previous years' testing and technology. I took a look at the gear hanging on my hook at the fire station. Both the coat and pants have three layers similar to those the first NFPA standard required. The materials and temperature rating have improved along with new additions of webbing integrated into the coat for rescue, multiple pockets for miscellaneous tools, and removable knee pads. The fire helmet still resembles Henry Gratacap's design but has better interior suspension, a chin strap,



(2) A uniform similar to what firefighter Steve Dircks started his career with. [Photo courtesy of Huron (OH) Fire Division.]

and a fire-resistant flap that covers the ears and neck. Leather boots, gloves, and a hood complete the turnout gear ensemble.

When entering a fire or smoke-filled environment today, the self-contained breathing apparatus (SCBA) provides great protection. SCBAs weigh much less than the early models but still have an air supply secured to the firefighter's back with shoulder straps and a waist belt. The air bottles are being made out of a composite material that can sustain high pressures. Integrated PASS devices turn on once the air bottle is opened, which sends out an audible alarm if the firefighter remains motionless, and transmits how much air is in the bottle to a receiver in the face mask. Personal escape ropes are also being added to the pack harness, and handles are designed into the back plate in the event of a needed rescue. Because of chemical, biological, radiological, and nuclear concerns in today's society, options are available to protect against these hazards. New standards will soon require these options.

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Turnout gear and SCBA manufacturers continue to design and produce new ways to improve firefighter safety (photo 3). Some of the future standards may include the following: increased thermal performance standards because materials burn hotter, heat sensors located in various locations throughout the turnout gear, and global positioning systems (GPS) integrated into the SCBA for better firefighter accountability, according to Mark Gibson, an SCBA technician.

Throughout history, firefighting personal protective equipment has evolved in many ways. Fire can be a harsh reality, but today's firefighters are much more prepared and protected than the firemen breathing through their whiskers years ago.



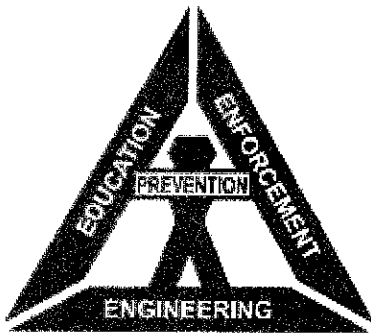
(3) The firefighting personal protective equipment of today has greatly improved from years past. (Photo by Lauren Yeagle.)

References:

1. Lamb, P. The Fire Helmet. Retrieved December 9, 2007 from the World Wide Web: www.petelamb.com/helmet.htm.
2. Lee, A., & Meyer, R. (2000, November). Escape Through Time. NOVA Online. Retrieved December 3, 2007 from the World Wide Web: www.pbs.org/wgbh/nova/escape/timefire.html.

About the Author:

Paul Hasenmeier has been a firefighter for the Huron (OH) Fire Division since 1999. He is a paramedic, a fire inspector, a SCUBA diver, and an instructor. He has an associate's degree in fire science, has gained knowledge in numerous technical rescue disciplines, and is a member of Ohio's Region I Urban Search and Rescue Team. He is a contributing author to School Bus Fleet magazine. Hasenmeier was a classroom presenter at FDIC 2008 and at the NY Fire Chiefs Conference and will be presenting at the Ohio Fire Chiefs Conference.



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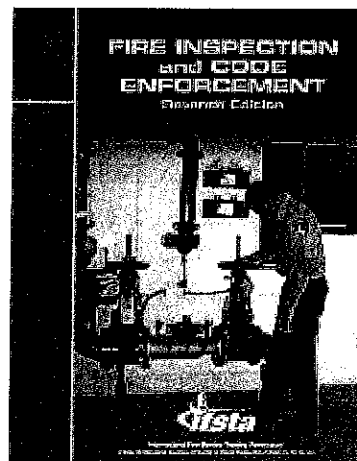
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