

# USDA Forest Service Fire Shelter Project Review Frequently Asked Questions

May 24, 2018

**Topic:** Fire Shelter Project Review

**Issue:** Recent fire shelter deployments and events in 2013 prompted the USDA Forest Service's Washington Office, Fire and Aviation Management (WO-FAM) to request acceleration of the life-cycle product review for the wildland fire shelter and supporting components. WO-FAM requested the Forest Service's National Technology and Development (T&D) Program to review the fire shelter system which includes the fire shelter, fireline pack, practice shelters and training. This fire shelter review had been scheduled to begin in 2015, but due to factors both internally and externally, the WO-FAM requested this review process start in 2014.

## Key Messages

- At the request of the Washington Office, Fire and Aviation Management, the National Technology and Development Program, located in Missoula, Montana, is conducting a fire shelter project review which started in 2014.
- The purpose of the review is to identify possible improvements to the fire shelter system in order to maintain and ensure the safety of wildland firefighters and fire personnel.
- Firefighters were surveyed in 2014 for their input concerning the current fire shelter, policy and development of new fire shelter goals.
- Survey results from the Fire Shelter Survey conducted in 2014 are posted on the NIFC website: [http://www.nifc.gov/fireShelt/fireShel\\_publications/ShelterSurveyResults.pdf](http://www.nifc.gov/fireShelt/fireShel_publications/ShelterSurveyResults.pdf). Responses from 3,803 firefighters nationwide were recorded.
- The goal of the fire shelter review is to explore materials and shelter designs that will maintain or improve the level of protection from radiant and convective heat exposure.
- The review will also maintain the current requirement of not exposing the occupant to dangerous levels of toxic components within the shelter.
- The review will also consider weight, bulk, durability and cost of the fire shelter system that includes the fire shelter, fireline pack, practice shelters and training.
- The Fire Shelter Project Review is open to all possibilities and will thoroughly explore all options during the review. Possible outcomes include transitioning to a new design; using the existing shelter with modifications; or keeping the existing shelter as-is.

## **FIRE SHELTER PROJECT UPDATE – MAY 2018**

Fire Shelter information available at: [http://www.nifc.gov/fireShelt/fshelt\\_main.html](http://www.nifc.gov/fireShelt/fshelt_main.html)

### **Shelter Material Search:**

- 23 companies have supplied material samples
- More than 200 material samples total
- Shelter finalists have been determined

The U.S. Forest Service entered into a collaborative agreement with the NASA Langley Research Center, located in Hampton, Virginia, to examine potential improvements to fire shelter performance. NASA and the U.S. Forest Service found that there are common performance requirements between fire shelters and flexible heatshields that can benefit both organizations.

North Carolina State University College of Textiles received a FEMA grant to initiate a project titled: Advanced Fire Blocking Materials for Enhanced Performance in Wildland Fire Shelters. NC State presented its findings to the NFPA technical panel in December 2017 and submitted a paper to the National Wildfire Coordinating Group (NWCG) Fire Shelter Subcommittee.

### **Fire Shelter Material Testing:**

- The Fire Shelter Test Protocol was used for testing material samples. Promising materials were used to construct full-scale fire shelters. Some of the shelters were tested in crown fire testing in the Northwest Territories of Canada as well as lab testing at the University of Alberta during the summer and fall of 2015 and 2016. The latest full-scale testing was conducted in October 2017.
- Until the September 2016 tests, the only materials that had a marked improvement in the thermal protective performance tests were those that were much heavier and more bulky than the current shelter material.

The NWCG Fire Shelter Subcommittee was briefed on the findings from fire shelter testing. The committee chose four different fire shelter styles for wear testing by firefighters this summer. Two of the shelter styles will be tested by line-going firefighters while two other styles of shelter, that are heavier and more bulky, will be tested by engine and equipment operators.

### **Fire Shelter Training:**

'*Fire Shelter Training Reminders 2018*' has additional training information that is posted on the Fire Shelter website: [http://www.nifc.gov/fireShelt/fshelt\\_training.html](http://www.nifc.gov/fireShelt/fshelt_training.html). This information should be used to supplement current training.

### **Fire Shelter Deployment Stories – Videos:**

The Beaver Fire Story of 2014 has been added to the Wildland Fire Lessons Learned channel of YouTube. <https://www.youtube.com/user/WildlandFireLLC>. All fire shelter deployment stories and common insights can be used to supplement current training.

The NWCG Executive Board, Risk Management Committee, Equipment Technology Committee and its Fire Shelter Subcommittee as well as the Fire Management Board of the Forest Service and the DOI agencies remain engaged in the project progress.

## **FREQUENTLY ASKED QUESTIONS**

### **What were the results of the 2014 firefighter survey?**

Survey results from the 2014 Fire Shelter Survey are posted on the National Interagency Fire Center (NIFC) website. Responses from 3,803 firefighters nationwide were recorded. Click the attached link for survey results:

[http://www.nifc.gov/fireShelt/fireShel\\_publications/ShelterSurveyResults.pdf](http://www.nifc.gov/fireShelt/fireShel_publications/ShelterSurveyResults.pdf).

### **What has the shelter material search yielded so far?**

Twenty three companies have supplied more than 200 material samples.

### **What types of shelter materials were submitted?**

The fire shelter material search is divided into three categories:

- Lighter weight and less bulk with similar performance to the current shelter.
- Similar weight and bulk with improved performance.
- Heavier weight and bulk with pronounced improved performance.

### **How is NASA participating in the fire shelter review?**

The U.S. Forest Service entered into a collaborative agreement with the NASA Langley Research Center, located in Hampton, Virginia, to examine potential improvements to fire shelter performance. A team of engineers from NASA is developing flexible heat shields that will protect spacecraft from the high temperatures of atmospheric entry under NASA's Hypersonic Inflatable Aerodynamic Decelerator (HIAD) project. NASA and the Forest Service have found common performance requirements between fire shelters and flexible heat shields that can benefit both organizations.

### **What fire shelter material testing has occurred since project initiation?**

The Fire Shelter Test Protocol is being used for testing material samples. Promising materials have been used to construct full scale fire shelters. Some of the shelters were tested in crown fire testing in the Northwest Territories of Canada as well as lab testing at the University of Alberta during the summer and fall of 2015 and 2016. The latest full-scale testing was conducted in October 2017. Until the September 2016 tests, the only materials that had a marked improvement in the thermal protective performance tests were those that were bulkier and heavier than the current shelter material. Recent testing has shown promising materials that will be “wear tested” this summer.

### **How will new fire shelter prototypes be tested this summer?**

This summer, a total of 60 wildland firefighters will carry one of the four new fire shelter prototypes for “wear testing” as part of the ongoing Fire Shelter Project Review that was initiated in 2014 to identify possible improvements to the fire shelter system. The intent is to evaluate durability of four different new shelters that have shown improved performance during lab testing.

### **What is the difference between the four fire shelter prototypes?**

Two of the new fire shelter prototypes are designed for line-going firefighters. Twenty of each of these prototypes will be issued to firefighters that are members of Interagency Hotshot Crews for

wear testing. The other two new fire shelter prototypes, which have been determined to be too bulky for line-going firefighters, will be tested by engine and equipment operators. Ten of each of the bulkier prototypes will be issued. NASA and the Forest Service have a cooperative work agreement for this project and two of the prototype fire shelters are NASA designs.

**How will you know if the wear testing was successful?**

After completion of the wear tests, the Forest Service’s National Technology and Development Program will evaluate the results and conduct a final round of full-scale direct flame testing to ensure the four new fire shelter prototypes are still able to perform after being carried by ground firefighters and engine and equipment operators over the summer. The final results will be presented to the NWCG Fire Shelter Subcommittee which will recommend whether to adopt one or more of the new fire shelter prototypes or to continue to use the existing fire shelter.

**\*\*NOTE:** It is possible the Forest Service will retain the existing shelter if there are no significant findings during this review. Options are to keep the existing shelter as is, use the existing shelter with modifications, or transition to a new design.

**What prompted the fire shelter design review?**

Recent and past fire shelter deployments and events in 2013 prompted the Forest Service Washington Office, Fire and Aviation Management (WO-FAM) to request acceleration of the life-cycle product review for the fire shelter and supporting components.

**Why was the fire shelter design review process moved up to 2014?**

This fire shelter review had been scheduled to begin in 2015, but due to factors both internally and externally, the Forest Service’s WO-FAM requested this review process start in 2014. Conducting fire shelter reviews is standard operating procedure. The National Technology and Development Program has a life-cycle review process wherein all personal protective equipment (PPE) is reviewed periodically to determine if new materials or designs are available. In addition to the life-cycle review process, new materials are continuously evaluated to determine if they may improve performance of the fire shelter or other personal protection equipment.

**Is this review process happening earlier than expected due to the Yarnell Hill Incident?**

The fire shelter design review process was scheduled for 2015, but significant events such as the Yarnell Hill incident involving the deaths of 19 members of the Granite Mountain Hotshots prompted leadership to re-evaluate the timeframe. The report states the temperatures, heat flux, and the radiant and convective heat of the burnover appear to have been well beyond the protective capabilities of the fire shelters and protective equipment.

**What is a fire shelter?**

The fire shelter is an aluminized cloth tent that offers protection in a wildfire entrapment situation by reflecting radiant heat and providing a volume of breathable air. The fire shelter is shaped like a half-cylinder with rounded ends; the previous version was triangular prism-shaped, similar to a small one person tent.

**When did firefighters begin using fire shelters?**

Wildland firefighters have carried fire shelters since they were developed during the 1960s. Fire shelters were required as personnel protective equipment in 1977.

**Are all federal, state, and local agency firefighters required to carry a fire shelter?**

All federal, state and local wildland firefighters carry the fire shelter (Model 2002). According to the National Fire and Aviation Executive Board (NFAEB) all agencies, cooperators and contracted resources were to transition to the new shelter (Model 2002) by January 1, 2010.

**Who makes the fire shelter?**

A contractor for Defense Logistics Agency (DLA) manufactures the shelters according to Forest Service specifications. The specifications include the exact materials to use as well as the shelter patterns and construction details. DLA administers the contracts. To ensure quality assurance and quality control, the contractor is regularly inspected by the Forest Service and Underwriter's Laboratory (UL).

**When should a fire shelter be used?**

Since firefighters are trained extensively in fire entrapment avoidance, fire shelters are used by firefighters in the very rare occurrence of a fire entrapment where firefighters feel the shelter is needed for protection from heat, smoke, and/or ember showers.

**How does the fire shelter work?**

The fire shelter provides protection primarily by reflecting radiant heat and trapping breathable air inside. The current shelter is comprised of two layers. The outer layer is woven silica laminated to aluminum foil. The foil reflects radiant heat and the silica cloth slows the transfer of heat to the inside of the shelter. An inner layer is fiberglass laminated to aluminum foil. The inner layer of foil prevents heat from being reradiated inside the shelter, and it prevents gases from entering the shelter. When the two layers of materials are sewn together, the air gap between them provides additional insulation.

**What types of heat can a fire shelter encounter?**

The current fire shelter works really well in radiant heat because the outside layer of aluminum foil reflects 95% of the radiant heat and temperatures inside the shelter rise slowly. Unlike radiant heat, convective heat from direct flame contact is more quickly conducted into the shelter, raising temperatures inside the shelter more rapidly.

**What are wildland fires temperatures?**

Wildland fires are typically 1600 degrees Fahrenheit; in some instances temperatures can reach 2000 degrees Fahrenheit. The most extreme temperature of a wildland fire measured was 2400 degrees Fahrenheit.

**What is considered a survivable temperature for humans?**

A tenable condition for an extended period for humans is about 250 degrees Fahrenheit. Humans can survive up to 300 degrees Fahrenheit for a short period of time.

**Has the fire shelter been field tested?**

The current fire shelter has been tested and shown survivable temperatures in typical exposures of 1700 degrees Fahrenheit with some flame contact.

**What kind of training do firefighters need to use the fire shelter?**

Wildland firefighters are properly trained in the use of a fire shelter. Required annual training includes, at a minimum, reviewing the training pamphlet, viewing the fire shelter training video, and practicing deployments using a practice fire shelter. Firefighters are trained that fire shelters are not fail-safe and to not take additional risks because they are carrying a fire shelter.

**How is the fire shelter carried, how big is it and how much does it weigh?**

Fire shelters are enclosed in a carrying case, worn on a belt, chest harness or as a component of the firefighter’s fire-line pack. A regular-sized current fire shelter weighs 4.3 lbs. and the carrying case is approximately 9 x 5¾ x 4½ inches.

**How is a fire shelter deployed?**

Firefighters remove the shelter from its protective container, unfold, and “shake out” the shelter, and get inside. Firefighters lay stomach-down on the shelter floor and slip their arms through the hand-hold straps, with their feet toward the advancing fire.

**Describe a shelter deployment scenario?**

Fire shelters are deployed in entrapment situations when firefighters feel they need to use it to prevent possible burn injury or death. Shelter deployment training stresses that firefighters deploy shelters in the largest possible area that is free of fuels. Optimal deployment sites include natural fuel breaks like wide stream beds and rockslides; gravel or paved roads (maintaining awareness of vehicles); areas cleared to bare mineral soil by mechanical equipment such as dozers; previously burned or “black” areas; or firefighter-cleared areas. Places to avoid for deployment include areas where shelters can be exposed to direct flame contact or convective heat such as narrow ravines (“chimneys”); steep slopes; draws; and saddles. Sites where rocks, logs, or standing dead trees (snags) can roll or fall onto shelters should be avoided if possible. Flammable equipment (such as fusees and chainsaw fuel) should be left outside and away from the shelter.

**Fire Shelter Deployment Statistics**

Shelter	Total Deployed	Precautionary	Burn Injury Prevented	Life Saved	Fatality
Old-Style	1100	500	300	300	20
M-2002	166	15	110	26	21

Source: [https://www.nifc.gov/fireShelt/fireShel\\_publications/ShelterDeploymentTotals.pdf](https://www.nifc.gov/fireShelt/fireShel_publications/ShelterDeploymentTotals.pdf)

**How was the current fire shelter developed?**

The original shelter was designed to reflect radiant heat, however direct flame contact could cause damage. Fatalities occurred when flame contact was severe. Development of the current fire shelter began in 2000. A worldwide material search was conducted. Small and full scale tests were developed to measure the strength, durability, flammability, thermal performance, and toxicity of various shelter designs and materials. The testing took place at the Protective Clothing Equipment Research Facility at the University of Alberta in Edmonton. More than 60 materials and combinations of materials were considered and 17 full scale designs were tested. Interagency Fire and Aviation Management leadership selected the new, current shelter from four final designs in June 2002.

**When was the current fire shelter introduced?**

The current shelter design was selected in 2002. The current fire shelter was introduced in 2003 and provided improved protection from radiant and convective heat. As part of the continuous improvement process, products and materials undergo continuous review and testing. Since 2003 more than 100,000 shelters have been manufactured.

**What is the difference between the old and current fire shelter?**

The old shelter was fiberglass material laminated to aluminum foil; the current shelter is silica cloth laminated to aluminum foil on the outside layer. Inside layer is aluminum foil laminated to fiberglass. It has a different shape – hut shape with rounded ends that reflect radiant heat better with a lower profile that can take direct flame better than the old-style.

**How has the performance improved with the current fire shelter?**

The current fire shelter has significantly improved performance due to the materials, construction and design. Additional protection from radiant heat is achieved with the utilization of two layers. Improved glue performance allows the shelter to maintain its integrity under higher temperatures. The rounded design provides better radiant heat protection than the old style. The greatest threats a firefighter faces during an entrapment situation are burns to the body and inhalation of hot gases, which can cause asphyxiation. Scientific estimates of the maximum survivable air temperature vary, but dry air temperatures as high as 300 degrees Fahrenheit are considered survivable for only very short periods of time.

There are physical limits to all materials. Although the current fire shelter offers significantly more protection, it cannot protect firefighters in all circumstances. Chances of survival improve if the fire shelter is deployed where it is not exposed to direct flame. A firefighter's highest priority is to avoid situations that can lead to entrapment.

**Need more information?**

More information can be found at: [http://www.nifc.gov/fireShelt/fshelt\\_main.html](http://www.nifc.gov/fireShelt/fshelt_main.html).

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