

APPENDIX D: EQUIPMENT FACTORS

This equipment report is based on both inspection of equipment and interviews of the Engine Crewmember and Division Supervisor (DIVS) who deployed a fire shelter on July 8, 2007, at the Alabaugh Canyon Fire near Hot Springs, South Dakota. Equipment inspection, firefighter interviews and follow-up interviews occurred between July 10 and 13, 2007.

Personal Protective Equipment – According to interviews, the Crewmember was appropriately equipped with personal protective equipment, while the DIVS had appropriate shirt, pants and hard hat, but did not have his gloves or fire shelter at the time of deployment.

Injuries – The firefighters received 1st, 2nd and 3rd degree burn injuries. Human skin begins to burn when the temperature of the skin reaches 131 degrees F.

Engine Crewmember:

Injuries before entering the shelter:

Right Face/Ear – 12 square inches 2nd degree burn

Injuries – time of occurrence unknown

Right Elbow – 2 inch diameter blister

Right hand lateral palm – ¾ inch diameter blister, right hand later swelled

Right calf above sock – 1 ¾ inch diameter blister

Left arm, triceps area – ½ inch diameter blister

Lower back – ½ inch diameter blister

Right hip – ½ inch diameter blister

DIVS: Injuries before entering shelter

Right Face/Ear – 36 square inches 2nd and 3rd degree burn

Right Hand – 2nd and 3rd degree burn

Left Hand – 2nd degree burn

Right Elbow – 12 square inches 2nd degree burn

Injuries occurred while inside shelter

Right Knee – 3 inch diameter blister

Clothing –The clothing showed some signs of heat, as described below, and performed as designed.

Engine Crewmember:

Pants – Manufacturer - Barrier Wear, NFPA 1977 Compliant

Material – Kevlar/Nomex, color – spruce green

Date Mfg. – 03/06

Size – 34/30.

Dye Sublimation is present on the lower right leg total 7 sq. in.

Gloves – No label present, but appear to be GSA

Manufacturer – FPI UNICOR

No damage

Boots – No damage

Shirt – Not available for inspection
Hard Hat – Not available for inspection

Division Supervisor:

Pants – Manufacturer - Western Shelter, NFPA 1977, 2005 Edition Compliant
Material - Kevlar/Nomex, color – spruce green
Date Mfg. – not legible
Size - M 30
Dye Sublimation is present on the lower left leg cuff.

Shirt – GSA, Manufactuer - Dawson Springs Co., FS Specification 5100-91E
Date Mfg. – not legible, most likely early 1990’s
Size – Large
No dye sublimation.

Note: Dye sublimation occurs when heat “cooks” the dye from the material and leaves an orange color in the green pants material. This occurs when the material reaches 450 degrees F.

Hard Hat – Manufacturer - Bullard
Model - 911, Full Brim
Hard hat was blown from his head and it was found near the deployment site. The suspension was melted and burned. The brim was warped. The polycarbonate of the hard hat begins to melt when the material reaches 350 degrees F.

Boots - No damage

Training – According to the firefighters’ red cards and interviews, both firefighters had fire shelter training with the New Generation Fire Shelter. Each had watched the training video and practiced shelter deployments with practice shelters.

Fire Shelter and Fire Shelter Bag: The fire shelter was inspected on July 12. It was examined for signs of heat and other structural damage.

Fire Shelter – New Generation Rev. C, GSA
Manufacturer – Weckworth Mfg.
Date Mfg. – 05/04
Size – Regular

- The fire shelter bag was not found; the red pull strip was found near the deployment site. It sustained very little heat damage and appeared to have performed as designed.
- The shelter showed very little sign of heat – only a few isolated spots (less than 1 inch in diameter) on the shelter floor, most likely from hot embers directly under the shelter.
- The shelter had a 3 inch tear of the floor material on the inside corner of the floor opening.
- On the same area of the 3 inch tear there was a 1 by 3 inch delamination of the foil.
- It appears the fire shelter performed as designed.

Escape – The DIVS led the Engine Crew member to the open grass from the timber patch. With most areas in flames the DIVS again led the Engine Crew member through a small notch with lower flames into a black area. With high radiant heat and heavy smoke in the black, the DIVS again led the Engine Crew member and adjusted their position within the black to avoid heat. The DIVS felt the black area would be a good safety zone. When a group of trees approximately 75 feet to their west (right side) torched, they both started to feel their faces burn. As he shielded his face with his hands, the DIVS told the Engine Crew member to deploy his shelter.

Shelter Experience – With eyes burning from smoke and snot running excessively, the Engine Crew member had difficulty removing the pack from his back – he released the chest strap, but forgot to release the waist belt. With the pack half off the firefighter unbuckled the waist belt. Kneeling, he quickly pulled the shelter from its pack and pulled the red pull strip of the shelter PVC bag. It slipped, so he gripped the pull strip tightly and jerked, tearing the pull strip and opening the bag. He had difficulty shaking out the shelter, so the DIVS aided by grabbing and spreading the shake handles, and quickly shaking the shelter open. A blast of wind with heat blew the DIVS' hard hat from his head; it landed 18 feet from their location. The DIVS stated that he experienced a very strong urge to run, but chose to stay with Engine Crew member and the shelter. With skin sloughing from his hands and face, he put the shelter over the Engine Crew member's head so he could deploy. When the Engine Crew member was mostly deployed, the DIVS asked if he could get in with him.

The DIVS dropped the radio and entered the rear of the shelter. The firefighters stated that once inside the shelter they both felt instant relief from the radiant heat. They heard the fire intensity increase outside the shelter. The Engine Crewmember was in one end of the fire shelter curled into a ball. The DIVS was sitting cross-legged at the rear of the shelter. Concerned for each other, they talked and prayed together. With the burns to his hands, the DIVS had difficulty holding down the shelter on his right side. His right knee was exposed for a short time and received heat. The Engine Crewmember said to the DIVS that his throat was swelling and that he was having breathing difficulty and thought he may have damaged his airway. Concerned that the Engine Crewmember injuries could become fatal, the DIVS exited the shelter to retrieve the radio to get help. Outside the shelter the heat was almost unbearable; he grabbed the radio which was extremely hot. He felt his burned fingers sticking to the radio. After several attempts to break into the radio traffic he was able to contact the Operations Chief (OPC3). After several minutes OPC3 was able to drive to their location. The Engine Crewmember rolled over and sat up in the shelter and attempted to signal OPC3 with his head lamp.

Discussion:

- Both firefighters participated in shelter training, but stated that they never thought that they would ever need to deploy a fire shelter in their fire careers.
- Both firefighters stated that they believe the fire shelter saved their lives.
- Judging from past experience, the DIVS felt the black area would be adequate as a safety zone.
- Due to heavy smoke and darkness the visibility at the deployment site was very limited.
- DIVS stated that he felt he should have instructed the Engine Crewmember to deploy his shelter much sooner - when they reached the black.

- At 5 ft. 9 in., 160 lbs. and 5 ft. 10 in., 190 lbs. respectively, both firefighters felt the shelter was large enough for both of them to “fit.”
- Areas on the east and west sides of the deployment site burned with enough intensity to take out most of the crowns.
- The deployment site inside the black appears to have provided considerable protection from the intense fire behavior. It appears there was no direct flame contact with the fire shelter.

Deployment Site Conditions:

- Size – approximately ½ acre, rectangle shape
- Site had burned shortly before the deployment, some ground was still hot.
- Most areas east and west of the deployment site burned in a high intensity fire that burned most of the tree’s crowns.
- The firefighters were exposed to mostly radiant heat while at the deployment site.

Recommendations/Reminders:

- If at all possible, firefighters should time their deployment so they are inside their shelters before dangerous heat arrives.
- Firefighters should practice shelter deployments in high stress environments with time constraints and while in different positions (standing, kneeling and lying down)
- In addition to practicing with a practice fire shelter, firefighters may need to do practice deployments with an actual New Generation Fire Shelter in order to become as proficient as possible.
- Firefighters should be aware of the increased risk for injury if they are not wearing or carrying personal protective equipment.
- Past deployments have shown face/neck shrouds have decreased burn injury to firefighters.

The New Generation Fire Shelter:

- This is the sixth known deployment of the New Generation Fire Shelter, but the first where two firefighters needed to be in the same shelter.
- Information learned from this deployment will be used to continue development work and information sharing on the New Generation Fire Shelter.

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