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FATIGUE and the FIREFIGHTER



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The severe fire seasons of recent years underscore the importance of doing everything we can to protect the safety and health of wildland firefighters. Managing firefighter fatigue is an important part of that effort. It's tired workers who are likely to injure themselves or put coworkers at risk.

This booklet talks about specific steps you can take as a manager or as a firefighter to control fatigue. It's based on my study of human performance in wildland firefighting for more than 20 years. The booklet is adapted from my 22-minute video, "Fatigue and the Firefighter's Environment," which is available from the Boise Interagency Fire Center (NFES 2071).

The message in this booklet is simple: Properly managing fatigue means more rested, productive people on shift and fewer accidents and injuries. This booklet will help managers and firefighters alike become more aware of, fatigue and the keys to controlling it.

Firefighting is hard, dirty, and dangerous. The fire itself creates much of that danger. But there's a less visible threat . . . fatigue. Without enough sleep and rest, after several long shifts in heat and smoke, even the fittest worker gets tired. Tired people can make mistakes. On a wildfire, mistakes often mean accidents and injuries.

If fatigue's an inherent part of firefighting, and a prime cause of accidents and injuries, is there much we can do about it? The answer is yes. Managers and firefighters alike can take actions to lower the stresses that cause fatigue. Here are the six keys to controlling the fatigue-related stresses of wildland firefighting:

- Work & Rest
- Heat Stress
- Smoke & Carbon Monoxide
- Food & Nutrition
- Physical Fitness
- Labor-Saving Techniques

Work & Rest

Sleep is a prime factor in controlling fatigue. Most of us can work hard for 24 to 36 hours with short sleep or rest breaks. After that, without adequate sleep or rest, we succumb to fatigue.

Studies that focus on how lack of sleep affects work performance during long shifts pretty much agree. For people to perform well at tough jobs like wildland firefighting, they should average 1 hour of sleep for every 2 hours of work.

This 2-for-1 ratio means that in a 24-hour period, a 14-hour shift is about as long as crews can work and still get the sleep and rest they need. It allows time for eating, showering, getting ready for work, and so forth.

Adequate sleep or rest is just as critical for overhead teams, and for drivers and heavy equipment operators. The safety of many depend on these people remaining mentally alert.

Incident management teams should establish work schedules that minimize fatigue by:

- Setting up recordkeeping systems that track crew work time.
- Striving to provide 1 hour of sleep or rest for every 2 hours worked.
- Putting only rested crews on a fire.
- Making every effort to sleep crews warm and dry.
- Providing shade and quiet sleeping areas for night-shift crews.

Breaks are a hedge against fatigue. For example, without frequent 10- to 30-second rest breaks between work operations, fatigue can rapidly overtake you. And breaks of 10 minutes or more keep performance from declining. The number and length of breaks should increase after 8 hours, because fatigue builds throughout a shift.

The pulse is a good way to gauge fatigue on the job. It can tell you if your breaks are long enough. Your pulse should recover to less than 110 beats per minute. Returning to work with a higher heart rate speeds fatigue.

Your wake-up pulse in fire camp can signal potential problems. If it's 10% or more above normal, it can mean fatigue, dehydration, even a pending illness.

Ample quality sleep is vital. It's possible to force tired muscles to keep on working. But the brain can't function properly without sleep. Accidents and injuries result among those pushed too much.

Heat Stress

Heat becomes a problem when humidity, air temperature, and radiant heat combine with hard work to raise body temperature beyond safe limits.

There are three forms of heat stress. The mildest is heat cramps. Heat stress can progress to heat exhaustion and heat stroke if you don't stop work, get to some shade, and begin drinking fluids. Heat stroke is a medical emergency. Delayed treatment can mean brain damage and death.

Sweat is your main defense. As sweat evaporates, it cools you. But rising humidity disrupts this cooling process. You sweat more, but it doesn't evaporate. No heat is lost.

So humidity puts you in jeopardy two ways: First, your sweat isn't cooling you. Second, you're losing large amounts of water as sweat. If this water isn't replaced, your body's heat controls breakdown. Your temperature climbs dangerously.

Maintaining a high level of fitness helps protect against heat stress. So does getting used to the heat—acclimating.

Regardless of how fit you are, or how well acclimated, fluid replacement is vital. During hard work in the heat, it's common to lose 1 to 2 quarts of sweat an hour. You must replace these fluids. This means drinking before work, drinking often while working, and continuing to replace fluids once off-shift.

In camp, drink juices and noncaffeine soft drinks. Both contain energy-restoring glucose. Stay away from caffeine and alcoholic drinks. They take water out of the body. On shift, drink at least every hour. Don't wait until you feel thirsty. Thirst underestimates fluid needs. And unless it's an emergency, never share canteens, to avoid spreading communicable diseases.

Everyone on the fire needs to understand the importance of drinking often. Replacing 12 or more quarts of fluid a day isn't easy. But it must be done when working hard in the heat.

You must also replace salt lost through sweating. Some people use commercial replacement drinks. But they are expensive, and the most important ingredient in them is water.

Fit, acclimated workers should be able to replace salt losses with the saltshaker. Unacclimated workers lose more salt in the heat, so they must pay more attention to replacing salt at mealtime. But they shouldn't over do it. Too much salt impairs temperature regulation and makes heat stress more likely. Excessive salt can cause stomach distress, fatigue, potassium loss, and mental confusion. Salt tablets are not recommended.

Pace yourself on the job. Heat tolerance differs among people. If you push too hard to keep up with others, you may not last the shift.

Whenever possible, avoid working close to flames. It's much cooler even a few feet away.

If you can, do the hardest work in cooler morning or evening hours. During breaks, try to get away from the heat. Check your pulse. Heat stress is unlikely if your pulse rate is under 110 beats per minute after 1 minute of rest or under 100 after 3 minutes.

Remember, physical fitness and heat acclimatization are important factors in combating heat stress. Unacclimated workers can't work at full capacity for several days. They'll need more rest breaks and plenty of fluids. In fact, crews with no heat acclimatization can only work at roughly half their normal capacity for the first few days.

Smoke & Carbon Monoxide

Unlike work/rest cycles and heat stress, which are more controllable, smoke and carbon monoxide present a bigger challenge to managers and firefighters.

Heavy smoke and CO are often present on the typical wildfire. Some exposure is unavoidable. Your objective must be to limit exposure.

We don't know enough about the health hazards of particulates and other constituents of smoke from wildland fuels. But high concentrations of particulates can irritate membranes and cause allergic and asthmatic reactions in some people. But little or no health risk is likely for healthy people when exposure is short.

The point is to limit exposure. To do that, managers should:

- Locate camps in smoke-free areas.
- Provide rest breaks out of the smoke.
- Rotate crews between smokey and less smokey work.
- Keep shifts short in heavy smoke.

When smoke levels remain bad for many days, managers should:

- Relieve those thought to be at high risk. People with heart conditions, respiratory ailments, and allergies, for example.
- Caution supervisors, crew leaders, and medical station people to be alert for problems associated with smoke and CO; for example, things like chest pain, asthma, or allergy symptoms.
- Instruct safety and medical people to continually monitor smoke levels.
- Suggest operators not smoke while driving or running heavy equipment.
- Discourage all smoking in enclosed vehicles.

CO is tasteless and odorless. It doesn't advertise its presence. But it's always found in the heaviest concentrations of smoke.

CO has an affinity for hemoglobin, the oxygen-bearing portion of red blood cells. This means it replaces oxygen in the bloodstream.

Too much exposure causes headaches, fatigue, drowsiness, and for some, impaired motor performance, decisionmaking, and cognitive function.

Because CO can hamper mental processes, it's particularly important that decisionmakers who influence the safety of entire crews get ample sleep. If exposure to CO and smoke is prolonged, overhead should have rest days in smoke-free areas. This is also true for those driving vehicles or operating heavy equipment.

Smoke and CO make a tough job tougher. They reduce work capacity, and can impair behavior and decisionmaking. They certainly speed up fatigue. And when altitude and CO combine, the ability to work a long shift is further compromised.

Currently, the manager's best defense against smoke and CO is limiting firefighter exposure.

Food & Nutrition

Good food is a morale booster in any fire camp. More important, food fuels the muscles for hard work. A good diet for any hard work is 60% carbohydrates, 25% fat, and 15% protein. Large quantities of carbohydrates are needed to replace muscle energy burned up working long shifts with handtools.

You need a variety of foods from the four major food groups: (1) dairy products; (2) meat, poultry, fish; (3) grains; (4) fruits and vegetables. Provide plenty of the foods rich in the electrolytes that control muscle function, like potassium with bananas, citrus fruit, and fruit juices; dairy calcium, and sodium using the saltshaker.

Fire camp meals present less a problem of getting enough of the right calories than do the lunches. It's not easy packing enough calories onto the line to fuel hours of hard work.

Include snacks that can be eaten throughout a shift. This helps maintain energy levels and slows fatigue. Keep in mind, during a long shift, you'll burn 4,000 calories above normal daily needs. That means taking in at least 5,000 to 6,000 calories a day! The fireline is no place to think about dieting.

Physical Fitness

Fitness is one of the most important ways to help control fatigue. Employee fitness goes hand in hand with productivity and safety.

Studies of firefighting and other field tasks confirm the link between fitness and work performance. Fit workers perform better in the heat. They acclimate faster and work with a lower heart rate and body temperature. They lose acclimatization slower and regain it faster.

Fit workers better cope with and recover from adverse firefighting conditions like long shifts and reduced sleep and rest. The physically fit employee misses fewer days of work because of illness or injury. And studies show that fitness boosts morale.

In short, fitness is the most important factor in predicting work capacity.

Work capacity is your ability to accomplish production goals without undue fatigue, and without becoming a safety hazard to yourself or coworkers.

There are two types of fitness: aerobic and muscular.

Aerobic fitness is a measure of the maximum amount of oxygen that you can take into your body and transport to the muscles. Oxygen intake is the most basic factor limiting work capacity.

Muscles need a continuous supply of oxygen to keep working. The more efficiently you deliver and use oxygen, the better you can do the tough jobs.

Many Federal and State agencies use the step test to predict aerobic fitness. Research continues to show the step test is a reasonably accurate, simple, and safe fitness predictor.

Muscular fitness includes both strength and endurance. Aerobic fitness and muscular fitness together are essential components of work capacity.

Muscularly fit workers are less likely to suffer back, knee, and ankle injuries common to working with heavy loads in steep, rugged terrain.

For all these reasons, supervisors should encourage fitness in their people and demand it of themselves.

But fitness can't be rushed. It's a gradual process. Depending on your present fitness, it may take 6 weeks or more of exercise to shape up. That's why prudent workers get in shape before the season begins. They don't work themselves into condition on the fireline.

Being overweight and out of shape makes the firefighting job harder and compromises safety and health. While the fit worker is more productive and less subject to the aches and pains of tough physical labor. Fitness is one of the best ways to protect against fatigue. So workers should come to the job fit.

Managers should encourage their crews to perform the physical training that keeps them in shape and that pays dividends on the fireline, shift after shift. And managers ought to be good fitness examples. There's no more powerful tool for convincing employees of the importance of fitness.

Labor-Saving Techniques

Even fit, well-rested firefighters will tire too quickly when they work inefficiently. Inefficiency wastes energy.

For one thing, new workers can be inefficient until they get instruction and practice in handtool use. For another, veteran firefighters are inefficient when saddled with the wrong handtool for the job. The right tool can minimize fatigue and energy expenditure.

A good example is the combi tool. It's about 20% more effective in digging fireline than the pulaski. The combi tool can build more line using less physical effort—a far more efficient way of working.

Another example is the fact that many firefighters must tote 30 to 40 pounds of gear to the line. This takes lots of energy. It would be much more efficient if most of this gear could be transported for them, perhaps by all-terrain vehicles or by some other method.

Suggested Reading

Fit to Work? NFES 1595, Boise Interagency Fire Center, Boise, ID.

Fitness and Work Capacity. NFES 1596, Boise Interagency Fire Center, Boise, ID.

Fitness Trail: Building, Signing, and Using the Trail. 8467 2501, USDA Forest Service Technology & Development Center, Missoula, MT.

Heat Stress. NFES 1594, Boise Interagency Fire Center, Boise, ID.

Even with more efficient tools, labor-saving techniques, physical fitness, and the other keys discussed here, firefighters, working long, hard shifts in the heat and smoke without adequate sleep, become fatigued. The point is to minimize fatigue by understanding the keys: Work & Rest. Heat Stress. Smoke & Carbon Monoxide. Food & Nutrition. Physical Fitness. Labor-Saving Techniques.

With these keys in mind, managers and individuals alike can do a better job to prevent unreasonable fatigue and reduce the risk of accidents and injuries.

