

CHAPTER 5

SAFETY

OBJECTIVES

- 1) Explain why fire safety must be given the same priority on prescribed fire as it is given on a wildfire.
- 2) Identify safety issues which should be addressed in the written safety section.
- 3) List recommended personal protective equipment items and explain their use on prescribed burns.
- 4) Relate standard principles of fire line safety to prescribed fire operations.
- 5) Explain the function and limitations of fire shelters. Deploy a fire shelter.

Attachment 1	Poisonous Plants and Insects
Attachment 2	Heat Stress
Attachment 3	Checklist and Crew Briefing Form
Attachment 4	Prescribe Fire Situations that shout "Watch Out"
Attachment 5	Safety Message Form

INTRODUCTION

Personal safety does not always receive the same emphasis on prescribed burns as it does on wildfires because people often think of prescribed fires as routine. Even experienced wildland fire personnel often cut corners on safety during 'routine burns.' Two factors associated with prescribed fires reinforce this *false* concept. First, prescribed fires are scheduled when weather and environmental conditions are favorable and second, the desired fire behavior is usually 'moderate' when compared to wildfires in similar fuels. In reality, there is only one difference between a wildfire and prescribed fire. That difference is the actual prescription process. In addition, a prescribed fire can transition to wildfire status in the blink of an eye. Studies of wildfire incidents have shown that many injuries and fatalities occur on "routine fires" and on "quiet" parts of the fire. Firefighters on 'routine' mop up have lost their lives when unexpected fire infernos erupted from the ashes of a dying fire. Likewise, many injuries and a number of fatalities have occurred on "controlled fires" across the nation either because fire behavior was underestimated or standard fireline safety precautions were not observed.

- 1) Fatalities Have Occurred On Prescribed Burns
- 2) Fatalities Have Occurred During Mop Up
- 3) Fatalities And Injuries Often Occur During Routine Conditions

All wildland fire is inherently dangerous and the same safety procedures are required on ***all fires*** including ***prescribed burns***. This presentation on prescribed burn safety will introduce safety precautions that individuals should observe during the burn and safety issues you should consider during the planning phase. We will look at the essential items of personal protective equipment that should be worn while engaged in prescribed burning, review the standard safety principles of the wildland fire environment, discuss hand tool safety and personal health safety. Safety planning is also an essential element of each prescription. Safety planning procedures will be reviewed and explained.

Additional safety training for prescribed burning is strongly recommended. Agencies and companies should identify minimum requirements of safety training for personnel assigned to positions associated with prescribed fires. Structured courses that are available that deal with wildland fire safety include:

- Fire Shelter Training
- S-130 Firefighter Training
- S-133 Look Up, Look Down, Look Around
- S-134 LCES
- S-190 Introduction to Wildland Fire Behavior
- S-290 Intermediate Wildland Fire Behavior
- S-390 Introduction to Wildland Fire Behavior Calculations
- Red Cross or Medic First Aid
- First Responder / Emergency Medical Responder

PERSONAL SAFETY

Personal safety on prescribed burns must have the highest priority. Actions which compromise safety cannot be tolerated. Individual responsibility is the key to personal safety. You, the prescribed burner, must accept responsibility for your own safety and act accordingly.

PPE

Personal Protective Equipment frequently called 'PPE' is the cornerstone of personal safety. Agencies and companies should have in place a policy that identifies the minimum requirements for PPE on all prescribed burns. In addition each individual should maintain a set of personal standards that insure personal requirements have been met. PPE requirements should be addressed in the written safety plan.

Personal Protective Equipment provides a measure of safety in what is an inherently unsafe environment. Recommended items of Personal Protective Equipment for prescribed burning include:

- o Fire Shelter (carried on belt or harness)
- o Hard hat
- o Eye Protection (goggles or shield)
- o Nomex Shirt and pants
- o Leather Gloves
- o Leather Boots
- o Respiratory Protection

*** Other PPE may include the following: radio, canteen, hearing protection, saw chaps, and compass.

Together, these items protect the prescribed burner from thermal and other job hazards while they work.

Fire Shelter

The fire shelter provides umbrella protection during fire entrapment and protects vulnerable airways and lungs, which the other components of the system cannot do.

Hard Hat

With the possible exception of the fire shelter, the hard hat may be most important piece of wildland firefighting safety equipment. Hard hats have saved many lives and prevented serious injuries by protecting the wearer against falling trees, limbs, and rolling rocks. In addition, the hard hat offers protection from direct flame impingement and radiant heat.

Approximately 15 percent of the body's heat is lost through the head, so hardhats, which are cooler and lighter in weight, are preferred over helmets designed for structural firefighting. Special clips are added to attach goggles and night firefighting headlamps. As more prescribed burns are conducted in areas where there are power lines and associated electrical hazards, Class B plastic hard hats, which provide electrical hazard protection, are preferred.

Goggles

Eye injuries account for five to ten percent of all wildland fire injuries. These injuries are usually the result of dust, smoke, brush, ash, or hot substances coming in direct contact with the eye. Proper eye protection (goggles, face shielded helmet or safety glasses) can prevent many of these injuries, therefore, it is an important component of the PPE system

Nomex Shirt and Pants

Flame-resistant clothes offer firefighters protection against flames, falling embers, coals and radiant heat. Current clothing includes flame-resistant Nomex shirts and pants. Like most fabrics, Nomex will burn if exposed to flame, but unlike other fabrics, it stops

burning when the flame source is removed. Instead of melting or burning to ash, it forms a char that continues to help protect the skin.

What to Wear with Nomex:

Two layers of clothing, that is, Nomex plus underwear, provide better thermal protection. All clothing worn under your protective apparel should be cotton or wool. Underwear of a polyester cotton blend is acceptable, but T-shirts and under shorts of 100 percent cotton are better. All-synthetic underwear should never be worn. Synthetics will melt and/or burn. Thicker knit fabrics generally provide better protection from radiant heat than thinner woven fabrics. Loose fitting clothing provides better protection in most circumstances and can help prevent serious injury in an entrapment. In Florida, the added benefits of thicker clothing must be weighed against the need to dissipate body heat and maintain proper body temperature. During growing season burns maintaining proper body temperature is especially difficult. For colder weather and nights, jackets should be all wool, all cotton, or wool blends of at least 85 percent wool.

Leather or Flame-Resistant Gloves

Specially designed gloves are essential in protecting the prescribed burner's hands against blisters, scratches, small cuts and minor burns during routine activities. They also play a major fire protection role in the event of an aircraft accident or fire line entrapment. Reports from people entrapped in shelters emphasize the importance of gloves in holding down hot shelter material without getting burned.

Leather Boots

Past fire entrapment investigations found that good quality leather boots traditionally worn for wildland fire fighting provide adequate foot protection. All wool or mostly wool socks offer added thermal protection. Wool wicks moisture away from the skin. This helps keep feet cooler and drier, reducing the chance of blisters, a common firefighting injury.

Most agencies require a lace-typed leather boot with at least an 8 inch top. Skid-resistant soles are required with a lug-type sole preferred. Slips and falls account for many fire related injuries. One study indicated that 17 percent of all injuries were slips and falls. The importance of good skid-resistant soles cannot be overemphasized.

Respiratory Protection

Unlike structural firefighters, prescribed burners should not be placed in a situation where respirators or other special breathing equipment is required. ***However, protection of the lungs and airways is always critical.*** During an entrapment, a properly deployed fire shelter can help meet this requirement.

In a normal prescribed fire environment, personnel should ***not expose*** themselves to any conditions where they ***may*** need a respirator. They may, however, be exposed to smoke, dust, and hot ashes. For limited protection, bandanas have been worn for years and dust filters and similar equipment are now common on prescribed burns. When wearing bandanas or dust filters, they should be kept dry. In intense heat, as when working

against a hot flame front, there is a possibility that breathing hot, moist air through a wet dust filter or bandana can damage the respiratory system. Furthermore, firefighters should not cover too much of the face. Cheeks and ears are excellent heat sensors. Covering them can lead a person to work too long in a hot situation. The result can be dehydration, heat stress, and prolonged elevated heart rate leading to premature fatigue, or worse.

Chain Saw Chaps

Since all firefighters don't wear them, chaps have not been included as a component of the basic PPE system. However, due to the wide scale use of chainsaws in firefighting, a brief review of this item is appropriate.

The outer shell is Cordura nylon, which cleans easily, resists tears and abrasions, and keeps the protective pads free of oil better than cotton canvas. The protective pads combine two layers of woven Kevlar with two layers of Kevlar felt. Kevlar is an aramid fiber like Nomex, but with more flame resistance. Moreover, because of Kevlar's cut resistance, it can slow and quickly jam the chain before cutters penetrate to the leg.

NOTE:

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FIRELINE SAFETY

Safety on the fireline requires a continuous commitment from all personnel. There is no standard operating procedure that covers all of the potentially hazardous situations that you will encounter on prescribed burns.

Fire safety officers have, however, developed a standard set of '**Watch Out**' Situations and '**Fire Orders**' that will help you become more aware of hazards and proper responses. In addition a simple four step process (**LCES**) addresses a wide range of hazardous wildfire situations.

The "Watch Out" situations should trigger an internal alarm alerting everyone that hazardous conditions exist. Once identified, appropriate steps can then be taken to isolate or minimize the hazard. While they were developed from wildfires, many of them also have application to prescribed fire. As you review this list, make notes on how each item may relate to prescribed fires.

Watch Out Situations:

1. Fire not scouted and sized-up.
2. In country not seen in daylight.
3. Safety zones and escape routes not identified.
4. Unfamiliar with weather and local factors influencing fire behavior.
5. Uninformed on strategy, tactics, and hazards.
6. Instructions and assignments not clear.
7. No communication link with crew/supervisor.
8. Constructing fireline without safe anchor point.
9. Building fireline downhill with fire below.
10. Attempting frontal assault on fire.
11. Unburned fuel between you and the fire.
12. Cannot see main fire, not in contact with anyone who can.
13. On a hillside where rolling material can ignite fuel below.
14. Weather is getting hotter and drier.
15. Wind increases and/or changes direction.
16. Getting frequent spot fires across line.
17. Terrain and fuels make escape to safety difficult.
18. Taking a nap near the fireline.
19. Personal protective equipment not available or not properly utilized.
20. Not familiar with equipment being operated.

The Fire Orders differ from the Watch Out Situations in that the Orders are generalized procedures for operating in a live fire environment. Just as with the Watch Out Situations, these were developed for wildfires but many are applicable to prescribed burning.

Ten Standard Fire Orders:

1. 1.Keep informed on fire weather conditions and forecasts.
2. Know what your fire is doing at all times.
3. Base all actions on current and expected behavior of the fire.
4. Identify escape routes and safety zones, and make them known.
5. Post lookouts when there is possible danger.
6. Be alert. Keep calm. Think clearly. Act decisively
7. Maintain prompt communications with your forces, your boss and adjoining forces.
8. Give clear instructions and be sure they are understood.
9. Maintain control of your forces at all times.
10. Fight fire aggressively, having provided for safety first.

Ten Standard Fire Orders:

Relate to the fire

1. Keep informed on fire weather conditions and forecasts.
2. Know what your fire is doing at all times.
3. Base all actions on current and expected behavior of the fire.

Relate to fire line safety

4. Identify escape routes and safety zones, and make them known.
5. Post lookouts when there is possible danger.
6. Be alert. Keep calm. Think clearly. Act decisively
11. Fight fire aggressively, having provided for safety first.

Related to organization control

7. Maintain prompt communications with your forces, your boss and adjoining forces.
8. Give clear instructions and be sure they are understood.
9. Maintain control of your forces at all times.

Many of the watch out situations and fire orders have common denominators. For example, communications is a common denominator in at least six watch out situations and five fire orders. These common denominators have been incorporated into a positive response system developed by Paul Gleason of the U. S. Forest Service. The LCES system identifies four basic components of fire line safety. These four basic components are essential for personal safety on the fire line.

L - Look-outs: Post lookouts in potentially hazards situations to monitor the hazards.

C – Communications: Weather it is face to face or over a radio communications need to be clear and understood.

E - Escape Routes: Pathways to escape hazardous situations. They need to identified and communicated with all personnel

S - Safety Zones: Areas that are big enough that you do not need to deploy a fire shelter within it. These locations need to be communicated to personnel.

In addition to these guidelines, the Florida Forest Service has also adopted watch out situations for prescribed burners. These Prescribed Fire ‘Watch Outs’ are listed in Attachment 5-3 at the end of this chapter.

SMOKE INHALATION AND CARBON MONOXIDE EXPOSURE

Prescribed fires can expose burners to large volumes of smoke. Because of this potential exposure, burn managers and participants should be aware of the health hazards associated with smoke on prescribed fire. Prescribed burners are required to spend considerable time on the downwind side of the burn unit because this is the area most susceptible to spot overs and escaped fire. Unfortunately, this is also the area where smoke is concentrated. Personnel should minimize their time in this zone by frequent rotation and by staying on the edge of this zone when possible.

Smoke from a fire is basically a suspension of particulates. Toxic fire gases can condense on these particles and enter the lungs. Small particles can reach the alveoli where they can do the most damage. The longer the exposure to smoke, the more damage can occur. Shortness of breath, coughing, and nausea are signs of smoke inhalation.

The best precaution for these hazards is to get out of the smoke as much as possible and to wear a dusk mask or cartridge type mask to filter out particulates and organic vapors. These masks will not, however, filter out carbon monoxide CO.

Treatment for those with symptoms of exposure to smoke is to move the victim to a smoke-free area. Severe exposure will require activation of the EMS system in your locality and administering oxygen if available.

Carbon monoxide is a colorless, odorless gas present at every fire. Under normal prescribed fire conditions with good ventilation and short term combustion, carbon monoxide should not accumulate at dangerous levels. With poor dispersion, sustained combustion and heavy smoke, carbon monoxide may be a problem. CO when present, attaches much easier to hemoglobin, (the oxygen carrying part of the blood) than oxygen does. The first sign of CO exposure is a headache. Other symptoms may include dizziness, faintness, 'cherry red' skin color, weakness, and nausea.

BURNS

No discussion of personal hazards encountered on prescribed burns would be complete without mentioning burns. Advances in PPE have greatly reduced the incidence of burns on fires but there will be times when a fire flares up or you grab the hot end of a drip torch without your gloves on.

The best prevention for burns is to adhere to the standard fire orders and wear your PPE. Be especially watchful when using a drip torch. First aid for burns depends on the depth of the burn into the skin. Superficial burns that just redden the skin should be cooled. A topical pain killer can be applied. Burns that blister the skin should be cooled and a clean

dressing applied. Burns that char or open the skin should be covered with sterile dressing and treatment obtained through the local EMS.

*** It is strongly recommended that a member of the burn team have first aid training, preferably at the first responder level, to provide competent treatment at the scene.

HAZARD AWARENESS

There are many hazards on a prescribed burn. Some are directly addressed in the watch-out situations and fire orders, but many other hazards may be present. Lookouts are sometimes designated for severe hazards, but each individual prescribed burner should constantly monitor conditions on the burn. This ‘simple’ process of maintaining awareness of your surrounding environment is not simple or easy. In fact certain crew members seem to have the knack for spotting problems. This knack is really the ability to monitor the surrounding environment for problems and to sound an alarm. Sometimes referred to as **situational awareness**, this ability is crucial for every prescribed burner. While some people seem to do this naturally, others must work constantly to improve their situational awareness. Do not become so involved with a single task that you do not pay attention. Take short pauses in your assigned duties and heed the advice at every rail road crossing “Stop, look and listen.” A related problem especially for experienced burners is a condition known as scotoma. A scotoma is a psychological blindspot. Any dangerous activity which is constantly repeated may produce this condition. A driver may fail to heed a stop sign at a familiar intersection or an experienced butcher may accidentally cut a finger. Reviewing watch out situations and special hazards before every burn will help prevent scotoma. In wildland fire many fatality reports begin with “Personnel on the fire considered it to be routine until...”

Hazard Examples:

Natural

Snags

Limbs

Poisonous plants

Animals defending their territory or young.

Terrain features

Insects

Weather

Wind shifts

Thunderstorms

Lightning

Erratic winds

Man Made
Heavy equipment
Canals
Old fence lines
Power lines

As you inspect burn units and develop plans look for specific hazards that may be present.

See ATTACHMENT 5-1 Poisonous Plants and Insects

WORKING IN HEAT AND HUMIDITY

Florida's climate is well known for its mild winters. Those who have participated in growing season burns know that heat and humidity can also make the Florida climate unique. With proper PPE, maintaining proper body temperature and avoiding fatigue can be a challenge. Failure to account for these conditions can be fatal. Drinking plenty of fluids and maintaining a proper electrolyte balance can help prevent problems.

Heat Stress: Heat stress occurs when humidity, temperature, radiant heat, and too little air movement combine with heavy work and clothing to raise body temperature beyond safe limits. There are varying degrees of stress from cramping to heat stroke. To prevent heat stress, maintain a high level of physical fitness, set a sensible pace, take frequent breaks in the shade if possible and replace fluids, (1 qt./hr. minimum). An expanded discussion on heat stress is included in this chapter.

See Safety Attachment 5-1: HEAT STRESS

Physical Fitness

Prescribed burning is physically demanding. PPE requirements and the routine work associated with prescribed burning, require strenuous physical activity and long hours. Escapes or spotovers demand an immediate response and these often occur immediately following prolonged activity. As a prescribed burn team member, each individual has a responsibility to maintain a level of fitness that will allow full participation in these activities. Meeting any agency standards for participation should be considered a minimum requirement. Each individual should strive for a level of fitness that insures full participation in their assigned role. It is most important to recognize limitations and restrict activity to roles within those abilities. Persons subject to heat or fatigue related problems should not be assigned suppression or holding duties on the fireline.

FIRE SHELTER TRAINING

The fire shelter is one of the most important items of PPE that you have. It will probably never be used but it could save your life and prevent serious injury. Remember, during an entrapment, protecting your lungs and airways are essential to survival. If your organization requires the use of fire shelters you should make sure that you periodically review your safety practices including fire shelter use.

PUBLIC SAFETY

Public safety has always been important, but in earlier times many prescribed fires had little impact on the public. Today, virtually every prescribed fire can adversely impact the public. With crowded high speed highways, well attended sporting and recreational events, and millions of new residents, smoke at the wrong place and time can wreak havoc. Smoke management is now a major component of every prescribed burn plan. Prescribed burners must also develop proper holding and contingency plans which recognize public safety as a high priority. In addition, escaped prescribed burns can threaten and destroy property and disrupt or displace residents, visitors and special events. These two elements when properly addressed in the planning phase, can provide needed safeguards for the general public. "

Safety Planning

Safety encompasses all aspects of planning a prescribed burn. Smoke management, ignition techniques, mop-up and fire line construction all require the incorporation of basic safety principles. Personal safety considerations outlined earlier are the cornerstone of this process. In addition each prescription should have a specific safety element. The safety section plan should include standard safety practices and communications, a medical emergency plan, specific burn unit hazards, public safety, and weather related hazards.

The Crew Briefing

Providing for an oral briefing on the day of the burn is as important as having a written plan. Safety should be specifically addressed in this briefing. During this briefing vital information from the written plan is reviewed and any new or updated safety information is presented. Anyone who does not understand his assignment or needs clarification, can ask questions. The oral briefing should be conducted by using a checklist which has been developed for that particular burn. Remember that a single checklist will not work for every burn. Leave space on your checklist to add items that are specific to your burn unit.

See ATTACHMENT 5-3 sample 'Crew Brief Check List' and ATTACHMENT 5-4 Prescribed Fire Situations That Shout "Watch Out"

Make sure that your burn team conducts a briefing prior to igniting **every** prescribed fire. Instructions and task assignments should be given, and follow-up discussion initiated to make sure they are understood. The ignition pattern should be reviewed and an opportunity given for clarification and questions. Discuss potential danger areas due to firing technique and ignition pattern, and from the combination of fuel, topography and weather. Discuss safety zones including 'in the black,' and escape routes from various parts of the burn. List hazards associated with the burn such as snakes, heat stress, dehydration, poisonous plants, and stump holes. Go over pertinent "watch out" situations. Everyone involved should be required to share any personal health issues which may prevent them from giving 100 percent in any emergency. Individuals should have an opportunity to decline participation if they are not 'fire ready.' Radio communications should be an integral part of every burn. When issuing radios, make sure everyone knows how to operate them and what channel(s) will be used. Use clear text and have crew members test each radio. Have a first aid kit on every burn and know where it is.

Make sure only authorized people are on the intended burn prior to ignition. If feasible, close the area for the duration of the burn. If public property, post this fact several days before the burn at all entrances to the area. Make it company/agency policy that no one is allowed on the burn while it is being conducted without the express permission of the burn manager.

THE WRITTEN SAFETY PLAN

Every prescription should have a section on safety. In addition, as stated earlier safety issues should be incorporated throughout the plan. The safety element should be clear and concise. It should include pertinent personal and public safety issues. The following list gives examples of specific categories which should be addressed.

- 1) Medical Emergency Plan
- 2) Required PPE and training
- 3) Communications
- 4) Key Florida Safety Issues
- 5) Specific Burn Unit Hazards
- 6) Public Safety Issues
- 7) Fireline Safety
- 8) Safety During Mopup

See the Safety Message form Attachment # 5

SUMMARY

This chapter provides a brief description of essential safety elements for prescribed burns. It is the responsibility of each individual to develop a good safety attitude and incorporate standard safety practices on every prescribed fire. In any business, safety is a matter of attitude and everyone doing things the safe way. For your personal safety, it is essential to review the principles of fire behavior, safe working practices, and the importance of effective communications in your prescribed burning operations. As you develop a good safety attitude, take the time to make sure **everyone on your team** is doing things the safe way.

ATTACHMENT 5-1

POISONOUS PLANTS AND INSECTS

THE PLANTS

Poison oak or poison ivy afflicts outdoor workers in every State except Nevada, Alaska, and Hawaii. These plants are a leading cause of field injuries and related workmen's compensation claims in the United States. In south Florida, poisonwood, a tropical shrub, can cause a similar reaction.

Poison oak and poison ivy plants can look alike, but their growth forms vary greatly. Poison ivy has a greater variety of leaf shapes than poison oak, although both have a characteristic triple leaf pattern. The plants can be shrubs growing 3 to 10 feet tall or long, woody, climbing vines. Poison ivy is often a plant growing less than a foot high. Poison oak is the name generally used in California, Oregon, and Washington for the shrub form.

Contact with either plant produces identical effects: itching, swelling, and painful blisters. A severe case can be disabling: itching and weeping blisters make sleep impossible; swelling of the face and eyes makes it hard to see; and when legs and groin are involved, it becomes difficult to walk. No medicine can completely protect against poison oak/ivy rash. Understanding the rash and how it is spread, can promote effective prevention measures. Steroid gels can minimize discomfort and speed recovery.

HOW THEY POISON

The plants' sap contains oil that causes an allergic reaction on the skin. Contacting the oil sets off a skin eruption that may vary from simple itching inflammation to water blisters. The plants are more likely to ooze sap when leaves are crushed or stems are broken. Leaves, stems, and roots contain the toxic oil. Any object touching the oil has potential to spread it to you. The berries and pollen are not toxic.

When the plants are burned, the toxic oil coats the soot, and this airborne material is also dangerous. Inhaling this smoke can cause fever and other symptoms.

The best way to prevent contamination is to recognize the plant and avoid it. Also, helpful is protective clothing. First aid for contamination is washing thoroughly with cold water. Calamine lotion helps relieve itching. Topical hydrocortisone ointments also provide some relief.

INSECTS AND TICKS

Insect stings and bites are 'a fact of life' when working in wildlands. Wasp, bee, and yellow jacket or ground hornet stings and fire ant bites are the most common. Ground hornets can be particularly aggressive when their nest is disturbed.

Keep a vigilant look-out for these insects and frequently check the ground where you stand for fire ant activity.

Reaction to bites and stings will vary considerably from person to person. People with known severe allergic reaction can obtain, through their doctor, a prescription for an injection kit to treat the reaction. Normal reaction to stings and bites, localized pain, swelling, itching, etc., can be treated on the scene with cold packs and a topical anesthetic, e.g., benzocaine.

Ticks are another problem in the wildland environment due to the possible contraction of Lyme disease. Lyme disease is a chronic debilitating disease caused by a spirochete that can be carried by the tick. Symptoms include a ring rash around the tick bite, followed by joint stiffness and fatigue.

Prevention is the best cure. Pay attention to your surroundings and maintain situational awareness. Proper use of PPE, even in hot and humid conditions will provide some additional protection. Do not use outer garments to wipe or dry exposed body parts since this may spread toxic material.

ATTACHMENT 5-2

HEAT STRESS

Wielding a Pulaski on the fireline or hiking with a heavy load is demanding work any time. But in the heat, under a glaring sun or near a flame front—it is even tougher. Sometimes the body can't cope with this added heat burden. The results can range from minor muscle cramps to exhaustion to often-fatal heat stroke.

Because firefighting is hot work, it is vital that you understand heat stress, how it affects you, and more importantly, what steps you can take to avoid it.

Heat stress occurs when humidity, air temperature, radiant heat, and too little air movement combine with heavy work and clothing to raise the body temperature beyond safe limits.

Sweat, as it evaporates, is the body's main line of defense against heat. As sweat evaporates it cools the body. In high humidity, sweating becomes more intense but doesn't evaporate, so no heat is lost. When water lost through sweating is not replaced, the body's heat controls breakdown and body temperature climbs dangerously, subjecting the body to heat stress.

HEAT STRESS DISORDERS

Heat Cramps These painful muscle cramps strike workers who sweat profusely in the heat and drink large volumes of water, but fail to replace salt lost in sweating. Maintaining proper salt (electrolyte) balance in body fluids is important. An imbalance causes tired muscles to cramp.

To treat heat cramps, drink lightly salted water (less than one teaspoon salt per quart); tomato juice; or, if you prefer their taste, "athletic" drinks. Static stretching exercises may relieve muscle cramps temporarily.

Heat Exhaustion Heat exhaustion is characterized by weakness or extreme fatigue; unstable gait; wet, clammy skin; headaches; nausea; and collapse. It is caused by inadequate water intake, salt losses, or both. The fluid loss leads to a drop in blood volume that severely limits work capacity. Salt imbalance also reduces the working ability of muscles. Treatment includes rest in a cool place and drinking lightly salted fluids.

Dehydration Exhaustion This form of heat disorder can occur after several days of work in the heat. If water losses are not replaced daily, progressive dehydration can severely reduce work capacity. Weight loss is the best indicator of progressive dehydration. A loss of 2 percent or more is accompanied by diminished work capacity. Exhaustion and collapse may follow weight losses exceeding 5 percent. Treatment includes fluid replacement and rest until water losses are restored.

Heat Stroke

Heat stroke results when the body's heat controls fail. It is characterized by:

Hot skin (*often dry*).

High body temperature (*106 degrees F or higher*), mental confusion, delirium, loss of consciousness, convulsions, coma.

Heat stroke is a medical emergency. Send for medical help at once and begin treatment immediately. Brain damage and death may result if treatment is delayed.

Rapidly cool the victim by soaking clothing with cold water and fanning vigorously to promote evaporative cooling. Continue until temperature drops. Treat for shock, if necessary, once temperature is lowered.

PREVENTING HEAT STRESS

It is not enough to know how to recognize and treat heat disorders. You must know how to prevent them. There are two keys, physical fitness and acclimatization.

Fitness

Maintaining a high level of physical fitness is one of the best ways to protect yourself against heat stress. The physically fit worker has a well-developed circulatory capacity as well as increased blood volume, important in regulating body temperature.

Fit people work with lower heart rates and body temperature. They start to sweat at lower body temperatures.

Fit workers adjust, or acclimate, to work in the heat almost twice as fast as unfit persons. Fit workers lose acclimatization more slowly, and are able to reacclimatize rapidly when again exposed to the heat.

Unfit workers who are overweight are even more unsuited for work in the heat. They have more weight without much increase in surface area for sweat evaporation.

Acclimatization

The person acclimated to work in the heat runs less risk of heat stress. The body adjusts to hot work in 4 to 8 days by:

Increasing sweat production.

Improving blood distribution.

Decreasing skin and body temperature.

Decreasing heart rate (beats per minute for the same job may drop from 180 to 150).

Acclimatization may be hastened by taking 250 milligrams of vitamin C daily.

About 1-1/2 hours of work a day in the heat is enough to acclimatize to a specific combination of work and heat. It provides partial acclimatization to more severe conditions.

Adjust to hot weather activity gradually. Set a sensible pace, take frequent breaks, replace fluids, and do not expect full production for the first few days.

Acclimatization persists for several weeks, but a tough weekend (fatigue, alcohol) leads to some loss.

ON THE JOB

Your best defense against heat stress is knowing when it is likely to strike. Temperature and humidity are your best clues:

Is it hot—thanks to sun or nearby flames?

Is the air still, with no breeze for cooling?

Is sweat dripping off your body?

Are you breathless, dizzy, chilled, and nauseous? Is your heart pounding at a rapid rate?

If the answer is yes to any of these questions, beware of heat stress. Ignoring these symptoms and continued hard work can have dire consequences.

Specific Steps to Prevent Heat Stress

Replacing Fluids

Drink lots of fluids. During hot work it is common to lose more than a quart of sweat an hour (about 1-112 percent body weight). In a hot, humid environment, sweat rates can approach 3 quarts an hour for short periods.

Maximum sweat loss is 8 quarts an hour for short periods. Maximum sweat loss in 8 hours is 8 to 12 quarts. Adequate replacement of water, salt, and potassium is vital to maintain your work capacity and to avoid heat cramps, heat exhaustion, or heat stroke.

To Prevent Dehydration

Drink 1 to 2 cups of juice or water before beginning work. Take frequent drinks during each hour of work.

Drink as much as you can at lunch and at the evening meal. Continue replacing fluids throughout the evening.

Remember, thirst always underestimates fluid needs. It is not easy replacing eight or more quarts of fluid a day, but it must be done when performing hard work in the heat.

Replacing Salt

Replace salt lost through sweating. Fit, acclimated workers should be able to accomplish this with the saltshaker at meals or by using 'athletic' drinks. Unacclimated workers lose more salt in the heat so they should pay particular attention to salt replacement at meals and during work.

Don't overdo it though. **Avoid salt tablets.** Too much salt impairs temperature regulation, and heat disorders become more likely. Don't continue high salt intake when you return to a cool climate or less arduous job. Excessive salt can cause stomach distress, muscle soreness, fatigue, impaired heart function, high blood pressure, potassium loss, and mental confusion.

Replacing Potassium

Potassium can become depleted over extended periods of work in the heat, so make potassium-rich foods like bananas and citrus fruits a regular part of your diet. Another approach is to drink lemonade, or tomato juice, as well as water, in quantities comparable to the fluid loss. Commercial "athletic" drinks also help make up potassium losses.

Work habits

Pace yourself. There are individual differences in heat tolerance. If you push too hard to keep up with others, you may not last the whole work shift. When possible:

- Avoid working close to heat sources.
- Do hardest work during cooler morning or evening hours.
- Change tools or tasks to minimize fatigue.
- Take frequent 10 to 30-second rest breaks as your work.

Rest Periods

Work-rest cycles must be adjusted to prevent progressive fatigue. Shorter work periods and more frequent rest periods in a cool, shaded area minimize heat buildup and progressive fatigue. Experience has shown that when:

Your pulse rate is under 110 beats a minute (after 1 minute of rest)

Or

Under 100 after the third minute of rest

Heat stress is unlikely during the workday. Ignoring these facts leads to fatigue and increased risk of heat disorders.

Protective Clothing

Modern flame-resistant clothing protects against sparks, embers, and brief exposure to direct flame. However, the fabrics that provide such protection reduce airflow through the garment that would normally cool the body by evaporating the sweat. Wear cotton T-shirts and under shorts to aid sweat evaporation. Avoid layers of clothing (vests, wool shirts, and so forth) that reduce airflow to the skin and add to the heat stress problem.

IN SUMMARY STRESSES ADD UP BECAUSE:

- Physical work in a hot environment is far more demanding.
- Heat stress and carbon monoxide (CO) have a greater combined effect than they do separately.
- Heat stress, fatigue, CO, and noise lead to more mental errors and a definite safety risk.
- Physical work, heat stress, and prolonged work periods combine to pose a threat to health and safety.

Always use caution and be aware of your working conditions, your body's reactions, and the reactions of those working around you under conditions that can result in heat stress.

ATTACHMENT 5-3

CHECKLIST AND CREW BRIEFING

A. Prior To Crew Briefing

- _____ Fire unit is as described in plan
- _____ Required firebreaks complete
- _____ Permits obtained
- _____ Official and neighbor notifications complete
- _____ Required equipment on site and functioning
- _____ Planned ignition and containment methods are appropriate
- _____ List of emergency phone numbers are available to everyone
- _____ Planned contingencies and mop-up are appropriate

B. Crew Briefing

- _____ Each crew member has a burn unit map
- _____ Fire unit size and boundaries discussed
- _____ Fire unit hazards discussed
- _____ Purpose of burn discussed.
- _____ Anticipated fire and smoke behavior
- _____ Review of equipment and troubleshooting
- _____ Check crew qualifications
- _____ Review organization of crew and assignments
- _____ Review methods of ignition, holding, mop-up, and communications
- _____ Review contact with the public; traffic concerns
- _____ Location of support vehicles
- _____ Location of back-up equipment, supplies and water
- _____ Review all contingencies including Escape Routes and Safety Zones
- _____ Review mop-up procedure.
- _____ Answer all questions from crew

C. Prior To Ignition

- _____ Weather and fuel conditions are within prescriptions
- _____ Current weather forecast obtained
- _____ Crew members have required protective clothing
- _____ Crew members have matches
- _____ Conduct test burn

D. Before Leaving Burn Unit

- _____ Mop-up completed as defined in prescription
- _____ Next morning inspection arranged

E. Note (on back) Any Modifications To Plan

Burn Leader _____ Date _____

ATTACHMENT 5-4

Prescribed Fire Situations That Shout "Watch Out"

You are burning with a plan that has not been approved by the appropriate agency administrator.

You are not a qualified Burn Boss but have been told to go ahead with the burn.

Objectives of the burn are not clear.

There are areas of the special concern within the burn unit that cannot be burned.

Private land and/or structure adjoin the burn unit.

You are uncomfortable with the prescription.

You have not requested a spot weather forecast.

You decide a test fire is not necessary.

You decide your personnel are old hands and a briefing is not necessary.

Escape probability is small so you do not bother with a contingency plan.

You or the Ignition Specialist is beginning to lose control of the ignition pattern after starting.

Mop-up and/or patrol instructions are not specified or understood by the holding personnel.

You have not lost one in a long time and are starting to feel a little smug.

ATTACHMENT 5-5

Safety Message

Incident: _____

Operational Period: _____

Major Hazards and Risk:

Mitigations to Avoid or Reduce Risk:

Safety Officer