Alaska Wildland Interface Firefighter

Student Workbook

Revised Edition-March 1999

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Foreword

You are about to begin a course that addresses a very real need in the fire service: the wildland fire in the wildland/urban interface. This is where the wildland firefighter and the structural firefighter meet and our jurisdictions and responsibilities overlap. As the public builds more and more homes in urban wildland settings, the risk of wildland fires threatening homes or structural fires spreading into the wildlands increases. This course was developed through a partnership between wildland fire service personnel and structural fire service personnel who saw a need to develop a shared course to prepare all firefighters, wildland and structural, to work together effectively and efficiently. The trend in the fire service is towards more cooperation, with structural fire departments assuming more responsibility for the wildland fire problem in their jurisdictions and the wildland agencies focusing more of their resources on protecting the same high-value interface. This course is only the first step in what we believe can be a fruitful cooperative effort. Working together, we can better meet our mission to protect lives, property, and the environment. It all starts and ends with you, the firefighter.

—Robert Purcell
Chief, Homer Volunteer Fire Department

"Wildfires require different tactics than structural fires do, and experience fighting one kind of fire is not readily transferrable to another. Yet, the very nature of an interface fire requires knowledge of both types of fire fighting."

—National Fire Protection Association, 1992

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Introduction

Objectives

Upon successful completion of this unit, trainees will satisfactorily identify:

1. The Wildland Interface Firefighter course objectives
2. Fatality and injury statistics associated with fighting wildland fires in the urban interface

Schedule of Events

Administrative Concerns

1. Time schedules
2. Classroom and field arrangements

Course Requirements

Completion of this course requires the trainee to

1. Complete the registration form
2. Attend 16 hours of this course and score at least 75% on the examination

Course Objectives

Purpose of the Course

Upon successful completion of this course, trainees will:

1. Understand the wildland fire organization, the interaction of tasks required when wildland fires meet the urban interface, and the universal command system required to stabilize a large emergency incident.
2. Identify the wildland fire tools and equipment used in the wildland/urban interface.
3. Identify wildland fire behavior and its influencing aspects in unconfined ground cover.
4. Determine the process of structure triage and how to safely prepare for the defense of those structures from wildland fire.
5. Recognize common Watch Out fire situations in the wildland/urban interface and relate survival techniques to those situations.

Note: The Watch Out Situations are listed throughout the workbook and the instructor's guide and are meant to highlight the significance of that particular topic for safety.

Fatality and Injury Statistics

This brief overview will examine many aspects associated with both wildland and structural firefighter deaths.

Unit I
Fire Organization

OBJECTIVES

Upon completion of the unit, trainees will satisfactorily identify:

1. Four agencies responsible for wildlands fire protection in Alaska
2. The Alaska wildland fire crew configurations and standards for performance
3. Employment requirements when working for wildland fire agencies and key aspects of the conditions of hire
4. The five functions of the Incident Command System and how the firefighter can interact with each of these functions

Alaska's Wildland Fire Season

The Alaska wildland fire season generally begins in May with the drying of the grassland areas. These fires are typically located near the urban interface. The fire hazard will continue until the grass greens up, usually by June. Daytime heating provides thunderstorm activity in interior Alaska during June and July, causing lightning fires. Resources are prioritized daily and mobilized to suppress fires depending on the fire management plan. If the weather patterns in the Interior continue hot and dry, wildland fires will generally continue to spread into August or until surface heating of the land tapers off. Man-caused fires can be expected in the wildland/urban interface any time fuels are dry enough to burn.

Fire Organizations in Alaska

1. Structure fire departments
2. State of Alaska, Division of Forestry (DOF)
3. U.S. Bureau of Land Management (BLM)
4. U.S. Forest Service (USFS)

Crew Organization

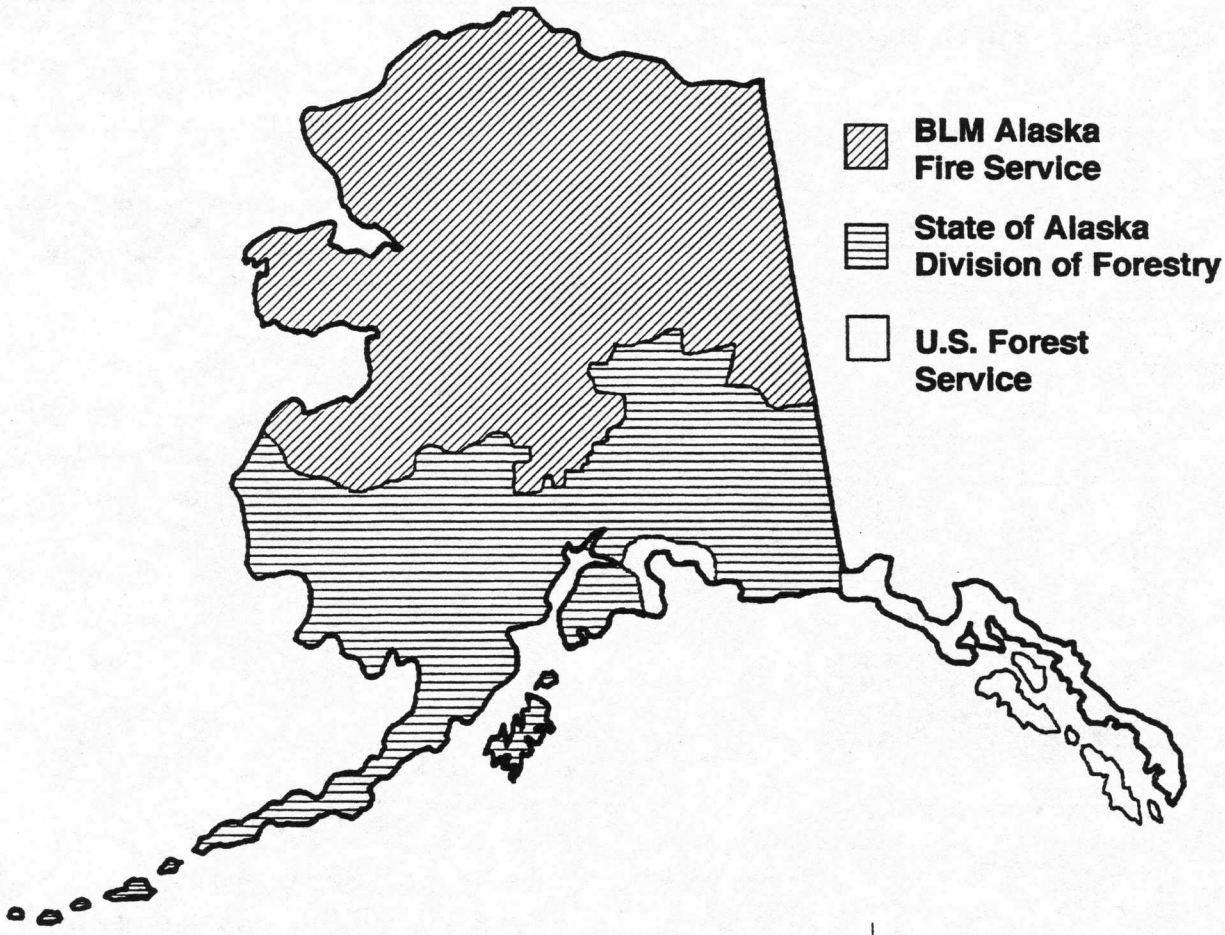
Whether working with engines, helicopters, or as a hand crew, all firefighters are organized into specific groups to suppress fire. Crews are used in initial attack, extended attack, and on project fires.

Engine Crews

Engine crews are referred to with the apparatus used to supply water and a water delivery system. Engine crews may be cross-trained to provide structure protection as well as suppress wildland fires.

Engine crews may be used in initial attack, extended attack, or project fires. In Alaska, engine crews or companies are trained and organized by municipalities, boroughs, the State of Alaska, and the U.S. government.

Crew size varies from two to five members, depending on the size of the apparatus that responds to an incident. Each engine has a crew leader or foreman. A strike team of engines is five engines with a leader and common communications.



Helitack Crews

Helitack crews are transported by helicopter to provide initial attack or support extended attack and project fires. Helitack crews are organized by the State of Alaska and the Bureau of Land Management. Each helitack load has a foreman.

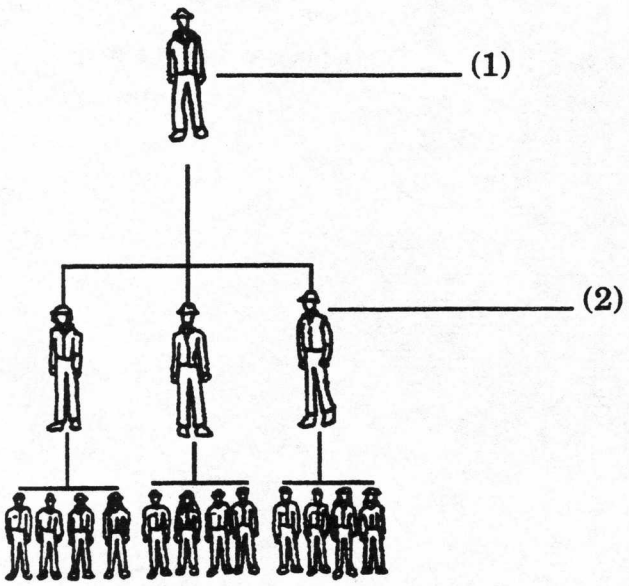
Crew size is determined by the size of the helicopter, usually less than 10 members on a helicopter load. Helitack crew members are trained in fire suppression, helicopter loading, manifesting, and as safety managers for transporting hand crews to the fireline.

Hand Crews

Hand crews are comprised of individuals who are organized and trained principally for fireline construction. There are two basic types of hand crews. A Type I crew consists of 20 members, has a high level of training and organization, and works seasonally on forestry and fire projects. A Type II crew consists of 16 members, trained and organized to perform on a call-when-needed basis. A Type II crew is more commonly known as an emergency firefighter (EFF) crew.

Exercise 1-1: Fill in the blanks as you learn the job titles:

EFF Crew Organization



_____ (1)

_____ (2)

_____ (3)

Helitack or Engine Organization

_____ (4)

_____ (5)

Wildland Fire Employment

Qualifications for Hiring

There are 73 organized Type II EFF crews in Alaska, and three organized Type I crews. In addition, local areas train and organize additional hand crews for fire suppression work whenever firefighters are needed.

Every person who works on a fire must have a current red card. A red card is an interagency record of a firefighter's training and experience. Red cards are issued by the firefighter's local wildland fire agency and are valid for five years. Your physical fitness must be tested each year via the step test or 1 ½-mile run.

Exercise 1-2: List four key items of the conditions of hire.

1.

2.

3.

4.

Crew Duties and Standards

Expectations of you as a firefighter:

- Abide by conditions of hire until time of release, both on and off duty.
- Complete work assignments within given time frames.
- Conduct yourself in an orderly manner while on the fireline, in fire camp, in travel, and on standby. Stay with your crew at all times.
- Work safely.
- Use safety equipment provided.
- Provide proper care for equipment and tools issued.
- Be on time, in the right place, with the right tools, in good condition to work.
- Follow the instructions of your crew boss unless prevented by unsafe conditions.
- Clean up after yourself on the line and in camp.
- Be cooperative. Consider the safety, welfare, and property of others.

Finance

Pay Rates and Workman's Compensation

Pay rates for state of Alaska EFF are listed on the EFF 1–5 scale.

Workman's compensation is provided but general health insurance and unemployment insurance are not.

Commissary

1. Cigarettes, chewing tobacco, and socks and personal hygiene items after five days, if authorized by the incident commander.
2. Additional commissary is on an emergency basis only, authorized by incident commander.

Claims for Injury or Personal Property Loss or Damage

1. Individual obtains treatment, provides information to complete proper forms, obtains witness statements, and keeps copies of forms provided.
2. Only personal property lost or damaged through no fault of the employee is covered.
3. Only items needed to do your job are covered for loss.
4. Fill out the required forms. The finance people will need prices and dates of purchase and a supporting witness

statement. Keep copies for your own records. You can send in receipts or catalog pictures with prices after you get home.

5. The process usually takes two to six months before claimant receives an offer.

Medical

Personal Health

The very nature of firefighting challenges your health. Dirty working conditions, physical labor, long working hours, and substandard diet take their toll on the body. It is important to pay attention to the minor details of keeping yourself in the best operating condition possible. Some considerations are:

- Do not share food containers.
- Do not share water containers.
- Stay hydrated. Drink water, not coffee or soda pop.
- Wash your hands regularly and frequently.
- Keep a clean and sanitary camp.

Injuries

The potential for serious injury, whether on or off the fireline, can be very high. By staying on top of minor health problems, using common sense, and watching out for coworkers, you can significantly reduce the chance of injury. Besides the common cuts, scrapes, bruises, small burns, and insect bites, serious injuries may include

- **Heat exhaustion:** symptoms are weak pulse, shallow breathing, and pale, wet skin. Victim can be dizzy and possibly unconscious. Treat by removing victim to a cool place and removing or loosening clothing. If conscious, give water. Fan victim to cool. Treat for shock by keeping the person lying down, elevating feet, and maintaining body temperature. Inform medical authorities immediately.
- **Heat stroke:** symptoms are sudden onset of unconsciousness and convulsions. Hot, dry, red skin with fast pulse and high temperature. Treat by quickly dousing victim with water and protecting the victim from self-induced injuries. Get help quickly.
- **Hypothermia:** symptoms of shivering and lack of muscle coordination become worse as body temperature drops. Can lead to unconsciousness and death.

Treat by removing wet clothing and warming body gradually. Extreme cases need an outside source of heat to rewarm them. The best treatment is to place the victim in a sleeping bag with another warm body.

Supply Issues

1. Volunteer fire departments place resource orders through state wildland fire dispatch to receive supplies from the warehouse.
2. Crew boss normally signs for supplies issued to crew.
3. Firefighter responsibility:
   - Proper care and maintenance of supplied items
   - Prevent loss of items and return to supply at demobilization

Out-of-State Assignments

1. Crew composition
   - Crew representative and usually three more firefighters added to crew (20 total)
   - Crew representative provides for safety and welfare by helping crew boss, who still gives instructions to the crew
2. Hazards and differences on out-of-state assignments
   - Poisonous snakes
   - High elevations and steep country
   - Larger trees than in most parts of Alaska
   - Poison oak or poison ivy
   - High temperatures in day. Dark, often cold at night.
   - Traveling for long distances in open bed vehicle or by foot
   - Unexpected fire behavior in unfamiliar fuel types
   - More concerns about environment and greater public visibility
   - More people, homes, and vehicles
   - Different food, often cooked for you by a caterer

Alaska Land Jurisdictions

Since prehistoric times, fire has played an important role in shaping the Alaskan environment. The northern boreal forest is a fire-dependent ecosystem that covers 588,000 square miles (357 million acres). In the last 40 years, data shows that lightning has accounted for 38% of the recorded

fires and 83% of the area burned. Human-caused fires accounted for 62% of the recorded fires and 17% of total acreage burned.

As the human population increases in Alaska, the number of homes in the interface between rural and forest land is rapidly increasing. It may be a few trapping cabins in remote areas, a small community, or a residential development near a larger city. The interface is not a remote wilderness situation; it is virtually everywhere. As this intermingling progresses, so do the problems relating to fire protection in populated areas.

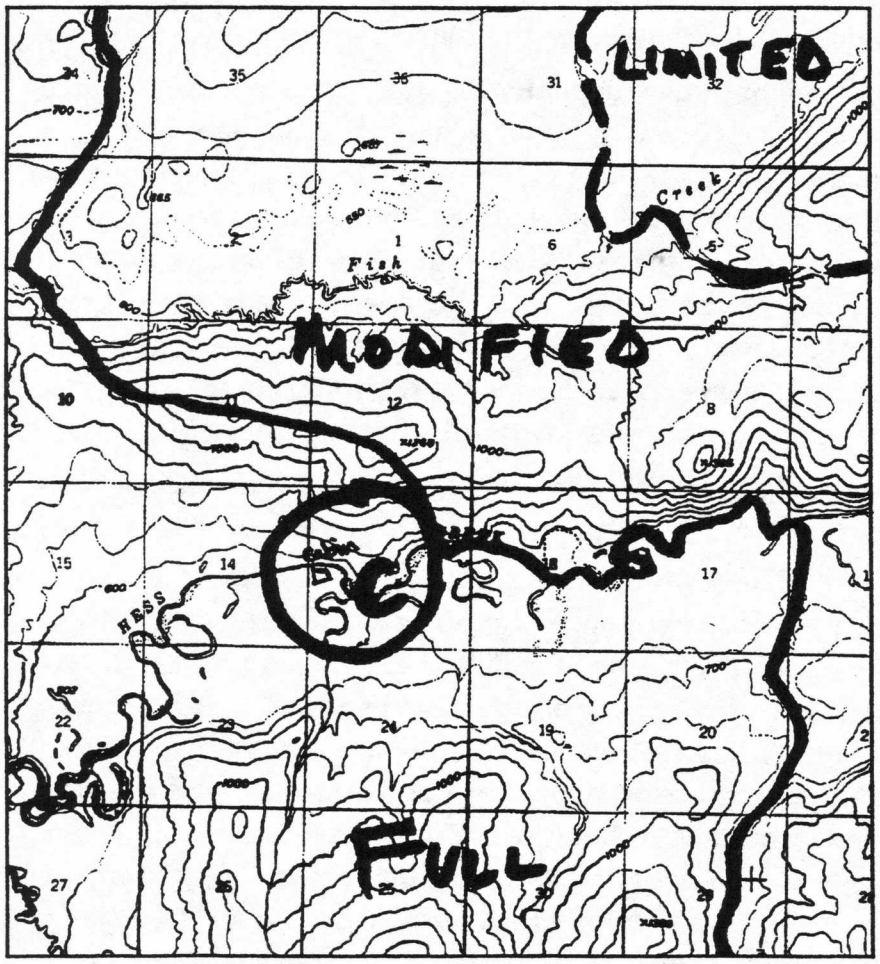
Alaska's wildland/urban interface fire program is managed to actively suppress fire to protect life and property and to not suppress fire in areas where those efforts are not cost effective and are a detriment to the health of the forest ecosystem.

Fire Protection Options

In 1980, as a result of the Alaska National Interest Conservation Act (ANILCA) the Fire Management Project Group was designated to organize and coordinate interagency fire management with in the state. This initial planning group was composed of representatives from land and resource management agencies, fire suppression organizations, and regional Native corporations. The state was divided into 13 planning areas, based on the features and the drainage of the land. The Alaska Fire management Plan consolidated these 13 plans and created four fire management options for land managers to use in determining the priorities for fire suppression. These options are Critical, Full, Modified and Limited land protection.

The **Critical** management option is specifically created to prioritize suppression action on wildland fires that threaten human life, inhabited property, designated physical developments, and structural resources designated as National Historic Landmarks. Priority over all other wildland fires is automatic for fires that threaten a critical site.

The **Full** management option was designed for the protection of cultural or historical sites, private property, natural resource high-value areas, and other high-value areas



that do not involve the protection of human life, human health, and inhabited property.

The intent of the **Modified** management option is to provide a relatively high level of protection during those periods when fires are likely to burn with greater frequency, intensity, and severity, and a lower level of protection when burning conditions are less severe. This option may reduce commitment of suppression resources when risks are low while providing greater flexibility in the selection of suppression strategies when risks are high. Modified provides a protection level between Full and Limited. The essential elements of this option are the evaluation date, described below, and the Escaped Fire Situation Analysis process.

During the critical portion of the fire season, all fires receive aggressive initial attack, unless otherwise directed by the land manager or owner. On individually predetermined

dates (July 10–20 in Alaska), each Modified protection unit automatically converts to Limited status.

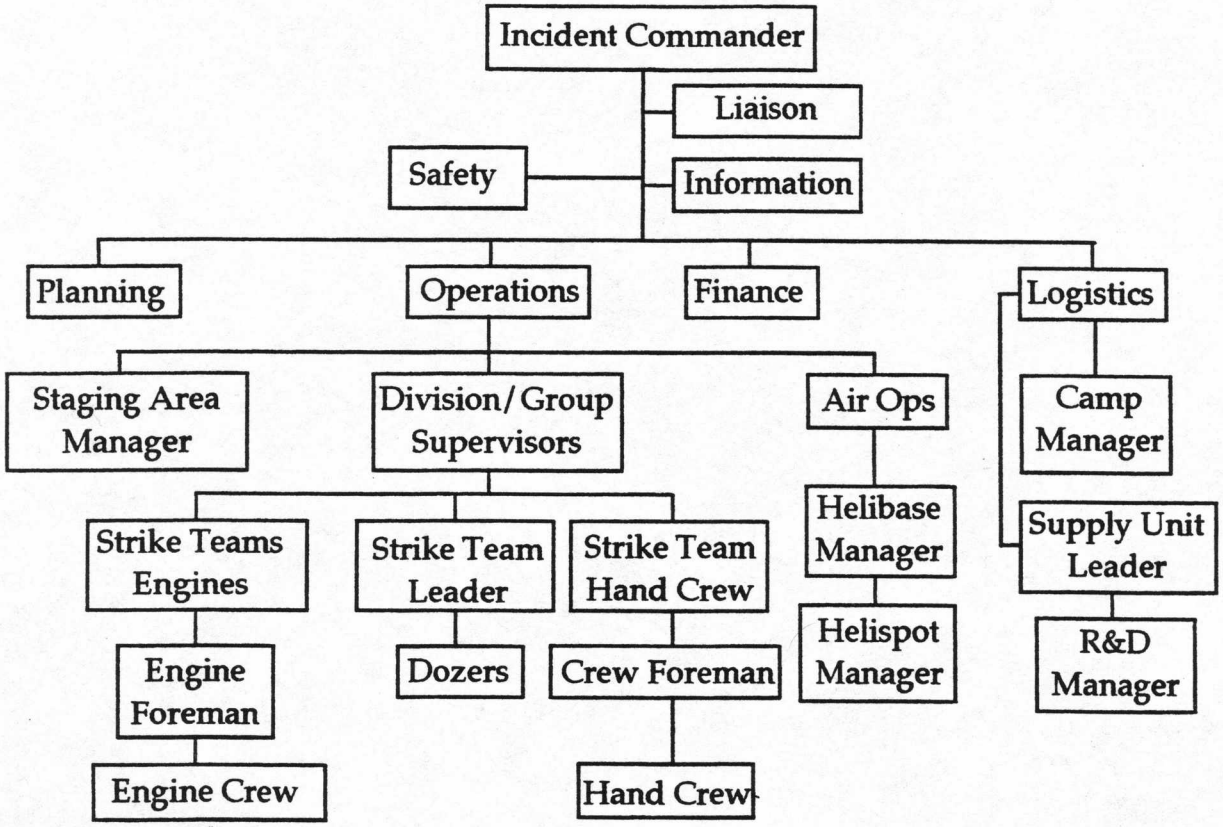
The **Limited** management option recognizes areas where the cost and/or environmental impacts of suppression actions exceed the value of the resources being protected. Suppression actions are initiated only to the extent necessary to keep a fire within the managment unit or to protect identified higher value areas/sites. Site-specific areas that warrant protection may occur within Limited management areas. Appropriate suppression actions to protect these sites will be taken when warranted, without compromising the intent of the Limited management area.

Incident Command System (ICS)

History of the ICS System

In 1970, several fires during a two-week period in California killed 16 people and destroyed 700 structures. Numerous problems involving communication and coordination hampered firefighting efforts. As a result, Congress appropriated funds to strengthen fire suppression command, control, and research. One product of the funding was the Incident Command System—a fire suppression command organization designed to deal with all kinds of emergencies (structure and wildland fire, earthquakes, oil spills, etc.) from the initial action to lengthy incident management situations.

The basic advantage of ICS is simply that various agencies can share resources with their neighbors and find ways to become more efficient and effective in times of emergency. When these agencies communicate with others in a common management system, they become a cohesive team. This leads to a greater understanding of each agency's mutual needs, priorities, resources, and responsibilities relative to the incident at hand.


Incident Commander
Liaison
Safety
Information
Planning
Operations
Finance
Logistics
Staging Area Manager
Division/Group Supervisors
Air Ops
Camp Manager
Strike Teams Engines
Strike Team Leader
Strike Team Hand Crew
Helibase Manager
Supply Unit Leader
Engine Foreman
Dozers
Crew Foreman
Helispot Manager
R&D Manager
Engine Crew
Hand Crew

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Unit II
Fire Behavior

OBJECTIVES

Upon completion of this unit, trainees will satisfactorily identify:

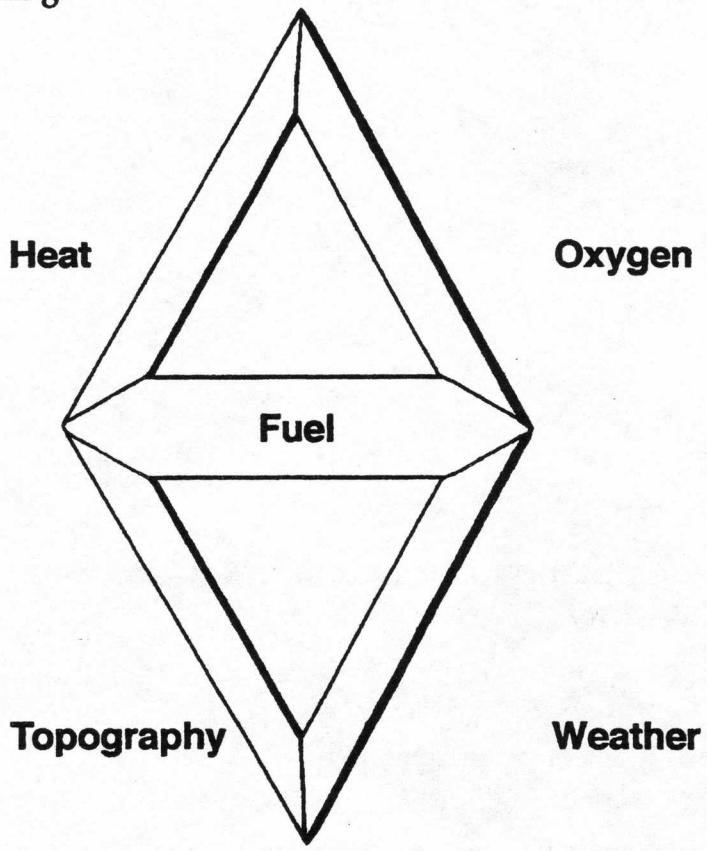
1. Two types of fire triangles referred to in wildland firefighting
2. Three types of heat transfer
3. How weather affects fire spread
4. How topography affects fire spread
5. The interactive effects of fuel, weather, and topography on the rate of spread and intensity of a wildland fire
6. Seven fire behavior words
7. The characteristics of fire behavior in four Alaska fuel types
8. Seven parts of a wildfire

Fire Components

Understanding fire behavior means knowing how a fire is likely to act under specific conditions.

Fire Triangle

The fire triangle (fuel, heat, oxygen) explains why the fire is burning.

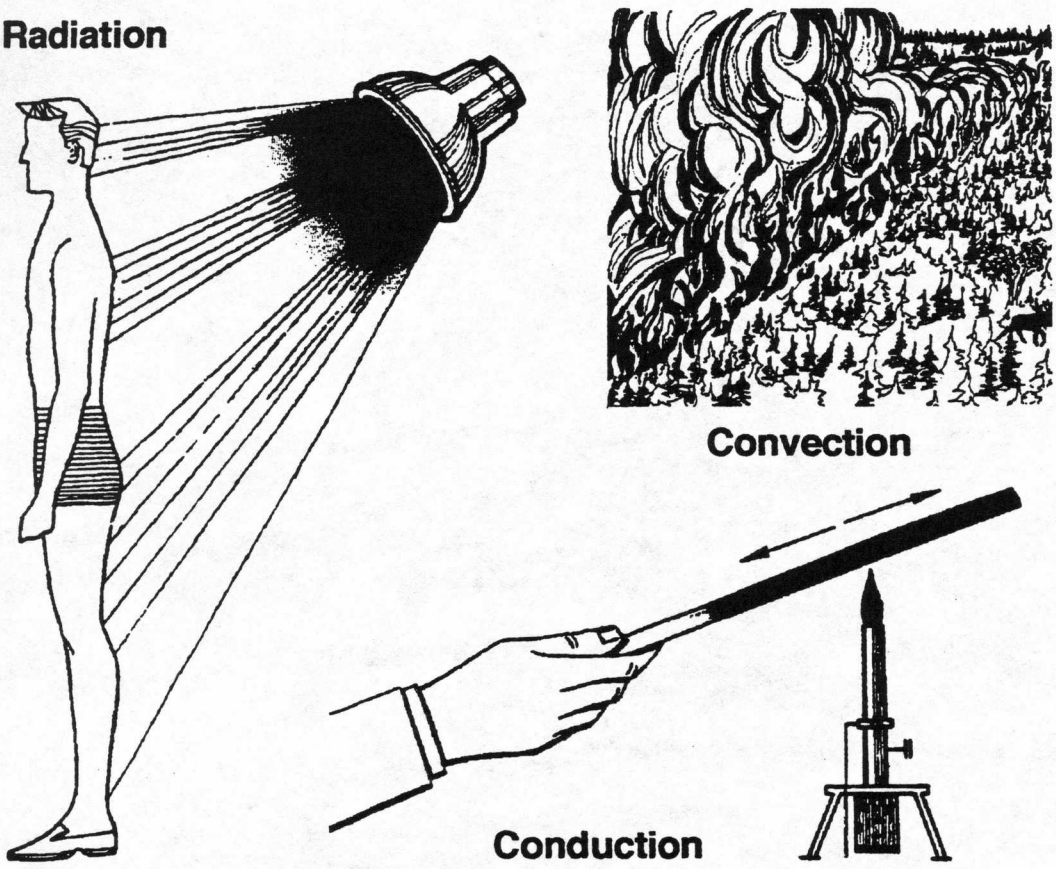


These are the components of the fire triangle. The top triangle represents what keeps the fire burning. The bottom triangle represents the "Big Three," or how a wildfire will spread.

Heat Transfer

Methods of heat transfer explain how heat from the fire helps it spread.

1. **Conduction** is the transfer of heat within the material itself. Occasionally, in deep seated duff and peat fire involving standing trees, the root system can transmit heat, frequently carrying enough heat to ignite leaves and duff across the control line.
2. The flame and burning fuel give off heat sufficuient to preheat the surrounding fuel. The warmth of the sun is an example of **radiation** heat transfer.
3. **Convection** is the transfer of heat by the movement of gas or liquid. In a wildland fire, convection occurs as heated air rises from the burning fuel.



The "Big Three" (**fuel, weather, topography**) determines how fast wildland fire spreads and how intense it burns.

The Big Three

Because a wildland fire has unlimited fuels in an unconfined space, certain factors must be considered to effectively determine a wildland fire **rate of spread** and **intensity**. Fuels are any material in the environment that will burn.

Fuels

Ground fuels: all burnable material beneath the surface that you walk on. Deep moss, duff, roots.

Surface fuels: all vegetation lying on and just above the ground. Needles, grass, dead logs, stumps, limbs, low brush under trees.

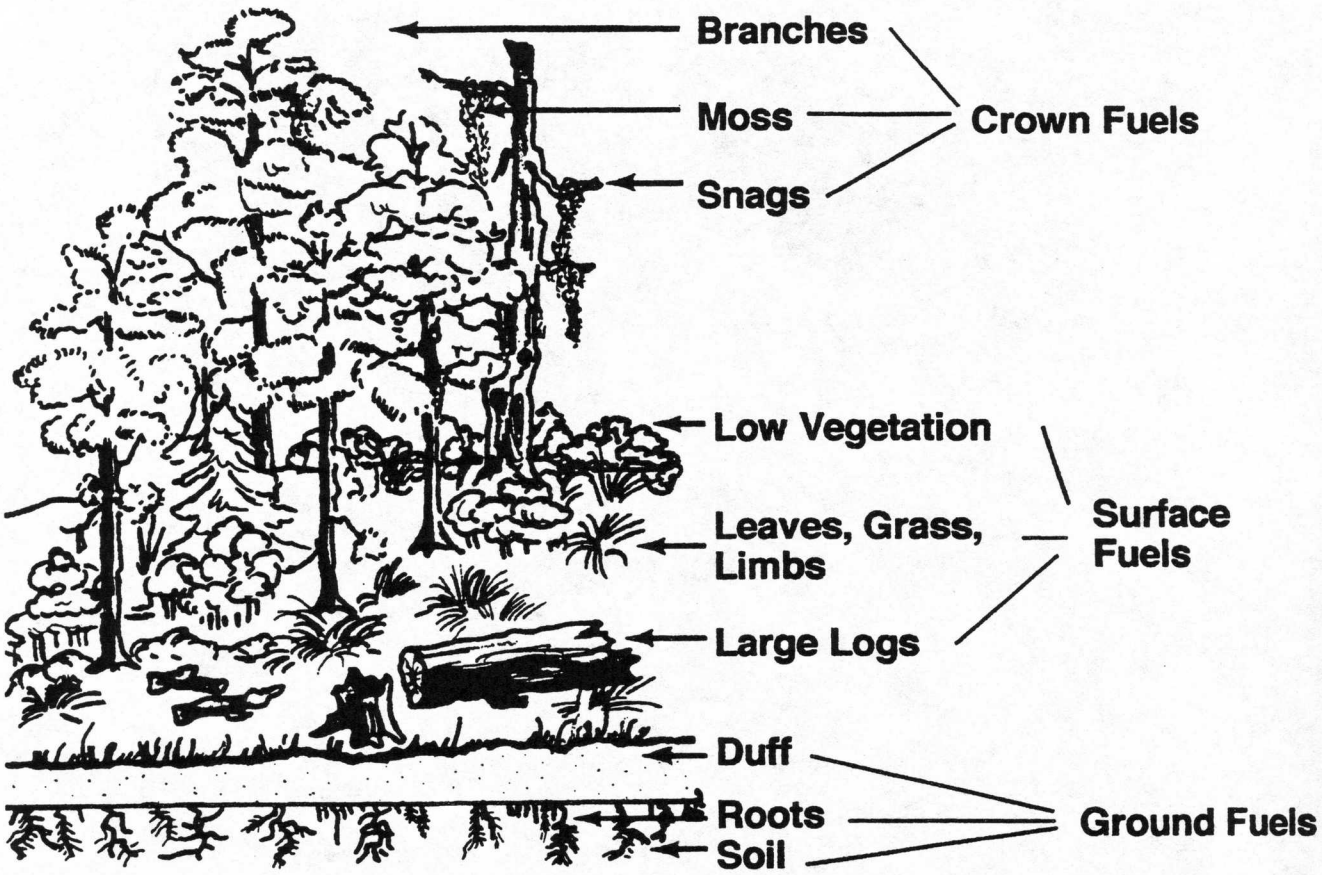
Fuel Levels

Crown fuels: the top of any type of vegetation, usually exposed to the wind. The top of forest fuels is called the crown.

Exercise 2-1: Fill in the blank for each fuel characteristic.

Fuel Characteristics

1. _____ are generally flashy or fast burning.



- Dry grass, dead leaves, needles, brush, and small trees.
- Fires travel rapidly and serve as kindling for heavier fuels.

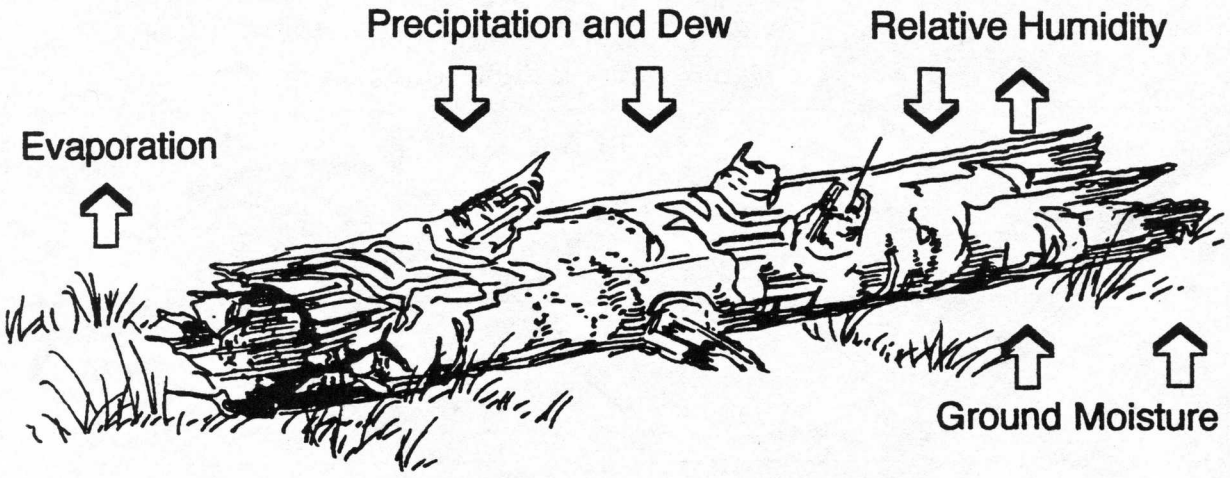
2. _____ are larger fuels that are slower burning at start but will burn with more intense heat once they reach combustion. Houses, trees, tree limbs, logs, stumps, and deep duff.
3. _____: the proximity of fuel particles to one another with respect to the free movement of air.

   Ground fuels, and some surface fuels, have a tendency to be tightly compacted and as a result have less air available than do crown fuels. It is the degree of compactness of certain fuels that cause them to burn more readily than other fuel types.
4. _____: size and shape of the fuels. This will affect how the air dries out the fuels.
   - Heavy, dense fuel particles dry out slow and get wet slow. Fires are hard to start and hard to put out.

- Light, fine fuel particles dry out fast and get wet fast. Fires either burn hot, or when the fuels are soaked they burn slowly or not at all.

5. _____ refers to the horizontal and vertical spacing of fuels.
   - When fuels are close together, the fire will spread faster because of the effects of heat transfer.
   - When fuels are patchy, scattered, or separated by natural barriers, the transfer of heat may not be sufficient to preheat or ignite the surrounding fuels. This will result in a mosaic fire spread or possibly no spread at all.
   - How fuels are spaced vertically in the fuel bed will affect fire spread.
   - **Fuel ladders** are the laying of material vertically, which contributes to a rapid climb from the surface to the aerial fuels.
6. _____ is the amount of water in a particle compared to its dry weight. It is a critical factor to the ignition of fuels.
   - High fuel moisture content: fires are hard to start and burn poorly if at all.

Moisture Exchanges With Wildland Fuels



- Low fuel moisture content: fires are easy to start. They spread and burn rapidly.

Watch Out Situations

#11 There is unburned fuel between you and fire.

- Stay alert for crowning and spotting.
- Know where your safety and escape routes are.
- Stay in voice or eye contact with supervisors.
- Consider burning out.

#17 The terrain and fuels make your escape to safety zones difficult.

- Know where the fire and your safety zones are at all times. If your zone to safety becomes threatened, consider evacuating immediately.

Weather

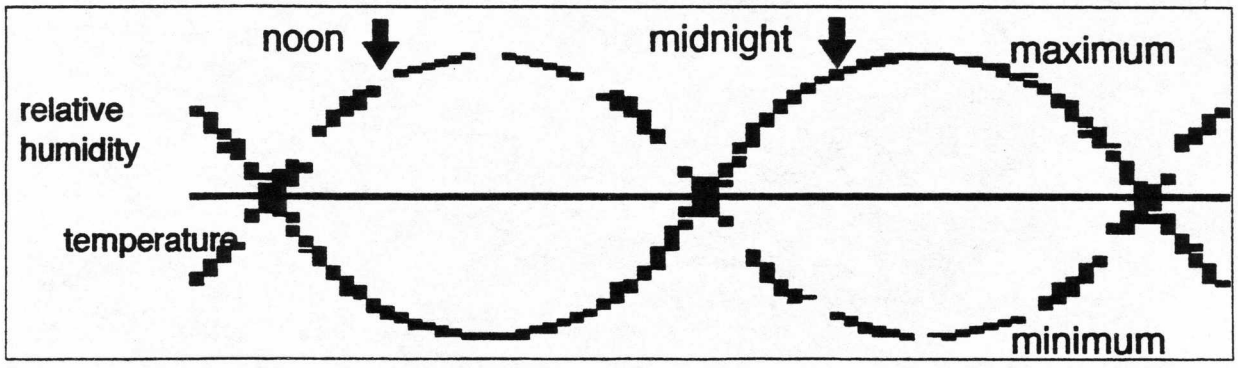
Weather is the condition of the atmosphere over the surface of the earth. Weather can rapidly change and has the greatest effect on fire behavior. Weather factors have caused the most fire-related deaths and injuries.

Air Temperature

Relative Humidity

Three factors of weather that affect fire behavior:

1. Air temperature—how hot the air is
   - changes every day as the energy from the sun changes
   - warm air dries fuel particles, reducing fuel moisture and making fires burn hotter
2. Relative humidity—how wet the air is
   - compares the actual amount of water in the air to what it could hold at that temperature
   - if temperature is high, relative humidity is low



- the higher the relative humidity, the higher the fuel moisture

Watch Out Situation

#14 The weather is getting hotter and drier.

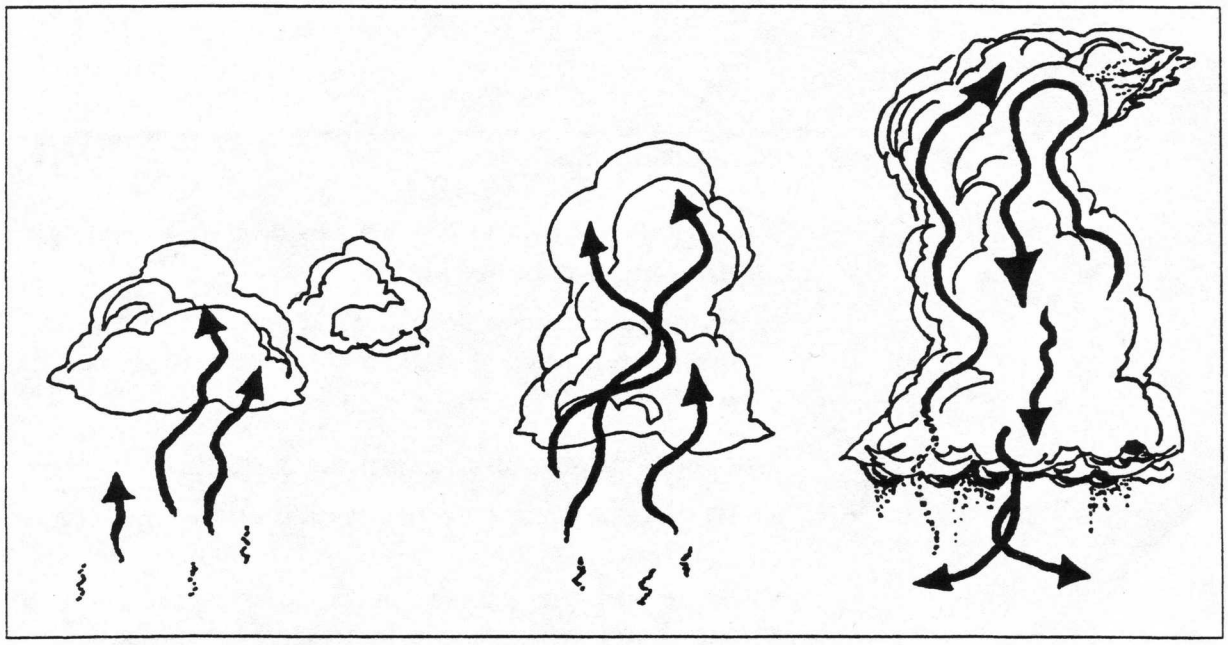
- Be alert for increased fire spread and longer flame lengths.
- Expect more spot fires and increased heat along the fireline. Make sure these areas are out before leaving them.
- Know your escape routes if fire blows up.
- Make sure you have enough drinking water, and use your suppression water wisely.

Wind

3. Wind is the **most important** weather factor affecting fires. Wind is air in motion, the result of temperature differences. Some different types of wind are:

Types of Wind

- **Upslope winds** are created by warm air rising from the uneven heating of the land.



- **Downslope winds** are created by cool air descending from higher elevations. Downslope winds are generally of a slower speed than upslope winds.

How Wind Increases Fire Behavior

- **Thunderstorm winds:** a thunderstorm is a rising column of moist air, convective in nature. Moisture condenses, forming clouds. If the air reaches the altitude where ice crystals form, a thunderstorm is born. Thunderstorm winds blow down from the cloud in all directions and at high speeds. Winds of 25 to 70 miles per hour may be observed. This could cause a quiet fire to blow up.
- **Whirlwinds** are upward spiraling vortexes that draw on new supplies of air as they move along the surface. Fire whirls are whirlwinds that carry fire and are threats to firelines because of the spotting potential.

Wind causes **tremendous change in the rate of fire spread.**

Exercise 2-2: List the five ways that wind increases fire behavior.

1.

2.

3.

4.

5.

Watch Out Situations

#4 You are unfamiliar with weather and local factors influencing fire behavior.

- Keep alert for changes in wind speed and direction, and inform everyone when you notice something different.

#15 The wind increases or changes direction.

- Be alert for increased fire spread and longer flame lengths.
- Make sure you can see the fire or post scouts who can. Look for increased spotting, firebrands, smoke, or other indicators of strong, shifting winds. Be aware of convective thunderheads.

Topography

Topography is the surface features of the earth, natural or man-made.

Slope is the angle of terrain. Fire will usually move faster uphill than downhill. The steeper the slope, the faster the fire will move. It is the most important factor of topography.

The **lay of the land** is the shape of the country:

Lay of the Land

- includes natural barriers such as rivers, lakes, rock slides, and nonflammable vegetation that breaks the fuel continuity
- inversions and drainages can affect fuel moisture
- canyons allow more effective preheating by radiation across the canyon
- chimneys increase channeling of convected heat and intensity of preheating

Slope affects fire behavior by:

Slope

- preheating fuels
- creating upslope winds
- bending flames closer to the fuels
- rolling debris can ignite fuels downslope

Aspect is the direction the slope faces.

Aspect

- south slopes usually are hotter and drier
- fuel characteristics can change with aspect

Watch Out Situations

#2 You are working in country not previously seen in daylight.

- Hazards increase in nighttime because of poor visibility.
- Keep good communications.
- Wear a head lamp if venturing into the darkness.

#9 You are building a fireline downhill with active fire below.

- A dangerous situation because of the probability of convective heat blow up. Know where your escape routes and safety zones are. If building fireline downhill, place scouts to constantly monitor the fire behavior and the weather factors that could change fire behavior.
- Expect and look for spot fires up slope. Be aware of rolling rocks and logs.

#13 You are on a hillside where rolling material can ignite the fuels below.

- You can be trapped between the main fire and spot fires. Make sure the line behind you is patrolled.
- Keep aware of safety zones. Move into a burned section if no other place is available.
- Dig cup trenches that will hold rolling logs, and turn logs so they will not roll down slope.

#17 The terrain and fuels make your escape to safety zones difficult.

- Know where the fire and your safety zones are at all times. If your zone to safety becomes threatened, consider evacuating immediately.

Fire Behavior Words

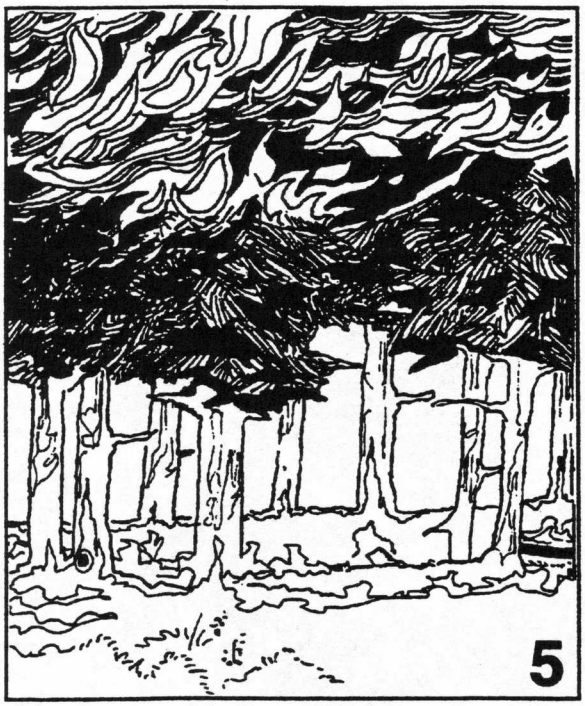
Exercise 2-3: Match these words with the pictures:

Smoldering _____ Creeping _____

Running _____ Torching _____

Spotting _____ Crowning _____

Blow up _____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7

Alaska Fuels and Typical Fire Behavior

Exercise 2-4: List the typical fire behavior for each fuel type.

Grasslands

Tussock tundra

Mixed hardwoods

Black spruce forest

Parts of a Wildfire

1. **Anchor point:** a place to start building a fireline along the fire edge. Often a place that is a barrier to the fire and keeps the fire from coming up behind you.
2. **Tail:** the slowest moving part of the fire edge, where flames are shortest or out. Sometimes where the fire started. Also referred to as "rear" or "heel."
3. **Flanks:** those parts of a fire's perimeter that are roughly parallel to the main direction of spread. Either side of the fire edge between the head and tail of the fire.
4. **Head:** the fastest moving part of the fire edge, where flames are longest. Sometimes there is more than one head.
5. **Spot fire:** a small fire outside the edge of the main fire, from a few feet to several miles.
6. **Islands:** unburned areas further inside the control line; could threaten the line by spotting.
7. **Fingers:** long, narrow extensions of a fire projecting from the main body.

Unit III
Tools of the Trade

OBJECTIVES

Upon completion of this unit, trainees will satisfactorily identify:

1. The benefits of wildland fire protective clothing
2. The major components of a water delivery system
3. The benefits of using wet water
4. Four types of water supply that may be found in the urban interface
5. Items needed to operate a Mark series pump
6. The difference between a simple hose lay and a progressive hose lay
7. Two advantages of hose packs
8. Four types of common hand tools in wildland firefighting, and two safe practices for each

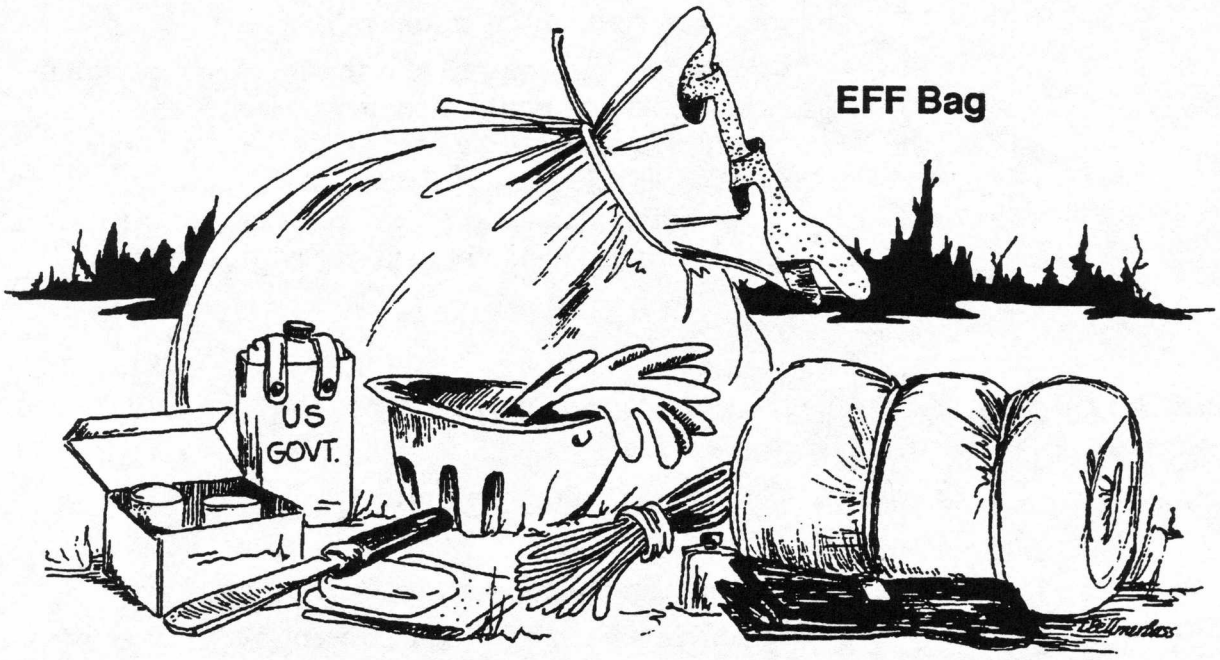
Personal Protective Equipment

Wildland personal protective equipment is designed to be lightweight, breathable, and fire resistant. It allows the wildland firefighter a degree of protection and mobility.

If structures are threatened in the urban interface, trained firefighters must prepare for structure firefighting in full turnout equipment and self-contained breathing apparatus (SCBA). If structures are not threatened, fire turnout equipment will not be suitable for wildland firefighting. The heavy material, vapor barriers, and the extra protection necessary for survival in confined structure fires can weigh nearly 50 pounds. The heavy equipment will soon overheat firefighters chasing fire over long distances and unknown terrain. Every year heart attacks and strokes are attributed to this mistake. Since both types of firefighting are different but must be responded to in the urban interface, both types of equipment should be available on first-response structure engines.

Wildland protective equipment includes

- Leather lace-up boots: leather with hard rubber soles. Eight-inch or higher tops. The height of the boots will protect the foot, ankle, and shin from radiant heat of



deep soil or ash pits. Firefighters are required to provide their own personal boots.

- Pants and shirts: fire resistant or nonsynthetic. Fire-resistant treated material (Nomex or other treatment) is preferred. Other recommended clothes are lightweight and nonsynthetic: denim, cotton, canvas, or wool. Pants and shirts should be worn over cotton undergarments.
- Fire shelters: a wildland firefighter pup tent made with heat-reflective material. It is a firefighter's last line of defense and must be available for use at all times. Storage cases are doubled for protection of the fire shelter.
- Emergency firefighter bags: firefighter equipment packed in duffel bags is compiled and distributed by state and federal fire agencies. The bag contains safety and camping equipment.

Exercise 3-1: List the items in the EFF bag.

- Lung protection: a bandanna or light scarf will provide some relief from smoke inhalation.
- Firefighters are required to bring their own personal clothing which should include rain jacket and pants, warm jacket (nighttime fires in Alaska can be cool), extra socks, underwear, pants and shirts, sufficient prescription medication, extra prescription eye wear, and toiletry items (toothbrush, eye wash, skin lotion).

Engine Supply and Delivery

Engines

Engines can be very effective for control of wildfire. Their uses include:

- Direct attack along the fireline
- Patrolling fireline
- Hot spotting to aid in direct attack
- Supplying water and foam concentrate through hose lays
- Supplying water and foam concentrate for backpack pumps, porta-tanks, or sumps.
- Protection of structures and improvements threatened by wildfire

Limitations of Engines

Possible limitations of engine use include:

- Fuels are too heavy to permit travel along the fireline
- Terrain is too rugged for vehicle travel
- Access is poor to and from the fireline
- Water supply is too far from the fire for effective operations
- Attempting to control the fronts on fast-spreading fires

Classification of Engines

Engines are divided into various wildland and structural categories depending on pumping capacity, tank size, hose carried, and personnel assigned on the engines. In addition, different agencies and organizations subdivide these engines. For simplification, in Alaska wildland brush engines are typed according to the gallons of water they can carry to an incident:

1. Light engines: 200 gallons and less.
2. Medium engines: 200–500 gallons of water.
3. Heavy engines: 500 gallons and more of water.

The type of assignment for an engine or strike team will help determine the best engine for the job. Mobile attack on grass fires requires an engine with the ability to make a running attack (pump and roll). Short wheelbase engines are generally better for off-road travel. The engine needs to be able to anchor the heel or tail or a fire and directly attack the flanks from inside or outside the burn. Stationary pumping on a hose lay may require an engine with a large water tank or a good water supply, depending on the volume of water needed. A high pressure or high volume pump may also be required.

The equipment on all engines is not standardized, thus there can be a problem for a trained engine crew transferring to an engine from another agency. Threads on fittings may not be compatible between engines from different agencies. Adaptors should be carried on the engines to meet local and mutual aid agency needs.

Not all engines have good drafting or refill capabilities. Without the proper drafting equipment, considerable down time can be experienced during refilling periods.

Hose Lines

1. Working and attack lines are used to directly work the fire.
2. Supplemental or backup lines are used to protect the structure, nearby exposures or your engine.
3. Supply lines are used to supply water for engines, tanks, or attack lines. These lines are typically larger.
4. Safety line: lines to protect a specific area such as the roof or an attacking engine.

Drafting

Drafting is drawing water from a static source for use in firefighting. Lakes, ponds, and rivers are static sources an engine could draft from. Drafting water from a static source requires a **noncollapsible** suction hose.

Considerations before drafting:

- Place the pump as close to the water supply as safety will permit. Solid foundations are important for pump placement. If your pump is on your engine, avoid boggy

ground and weak support. Remember you engine will be TONS heavier when filled with water.

- Tighten hardware to create a good suction.

Water Supply

Where the water is located and how much is available to fight a wildland fire could decide the success of suppressing a fire.

Fold-a-tanks

Collapsible or fixed portable tanks can be used to provide water storage and supply in remote fire locations. Engines or helicopters can transport a fold-a-tank, dump their initial water supply, and then support the water delivery system as tenders. Fold-a-tanks vary in size up to 3,000 gallons capacity.

Considerations regarding placement of tanks:

- access for delivering equipment
- level ground
- gravity feed supply to the delivery system
- tie-down requirements for aerial supply

Environmental Supply

The natural environment can be your best source of water supply on a wildland fire. Firefighters should be aware of natural creeks, ponds, swamps, rivers, lakes, and oceans to resupply their water. Local maps and local expertise will assist in your search for water supplies.

Man-made Supply

Firefighters may use water from hydrants or from the homeowners' supply. Wells, cisterns, swimming pools, and hot tubs can be used. Private tenders with tanks can be hired from the public.

Water Delivery

Portable Pumps

Eight Items for Operation

Exercise 3-2: List the eight items needed for a Mark series portable pump operation.

1.

2.

3.

4.

5.

6.

7.

8.

Starting Procedures

Starting procedures for a Mark 26 or III pump:

1. Prime the pump
2. Choke
3. Throttle to start position
4. Charge fuel line
5. Pull cord
6. Warm up for two minutes

Shutdown Procedures

Shutdown procedures:

1. Idle for two minutes
2. Shut off pump

Hose Lays

Simple Hose Lay

A **simple hose lay** is one that comes straight off the pump and goes directly to the nozzle with no junctions in between.

Advantages:

- Quick and easily installed
- Minimal friction loss

Limitations:

- Water flow must be stopped before it can be extended by adding a length of hose
- No provisions for safety should the fire flare up behind the nozzle operator
- Difficult to mop-up since you must either reverse the installation process or pull large amounts of hose

Progressive Hose Lay

A **progressive hose lay** incorporates a series of lateral lines off of a main trunk line.

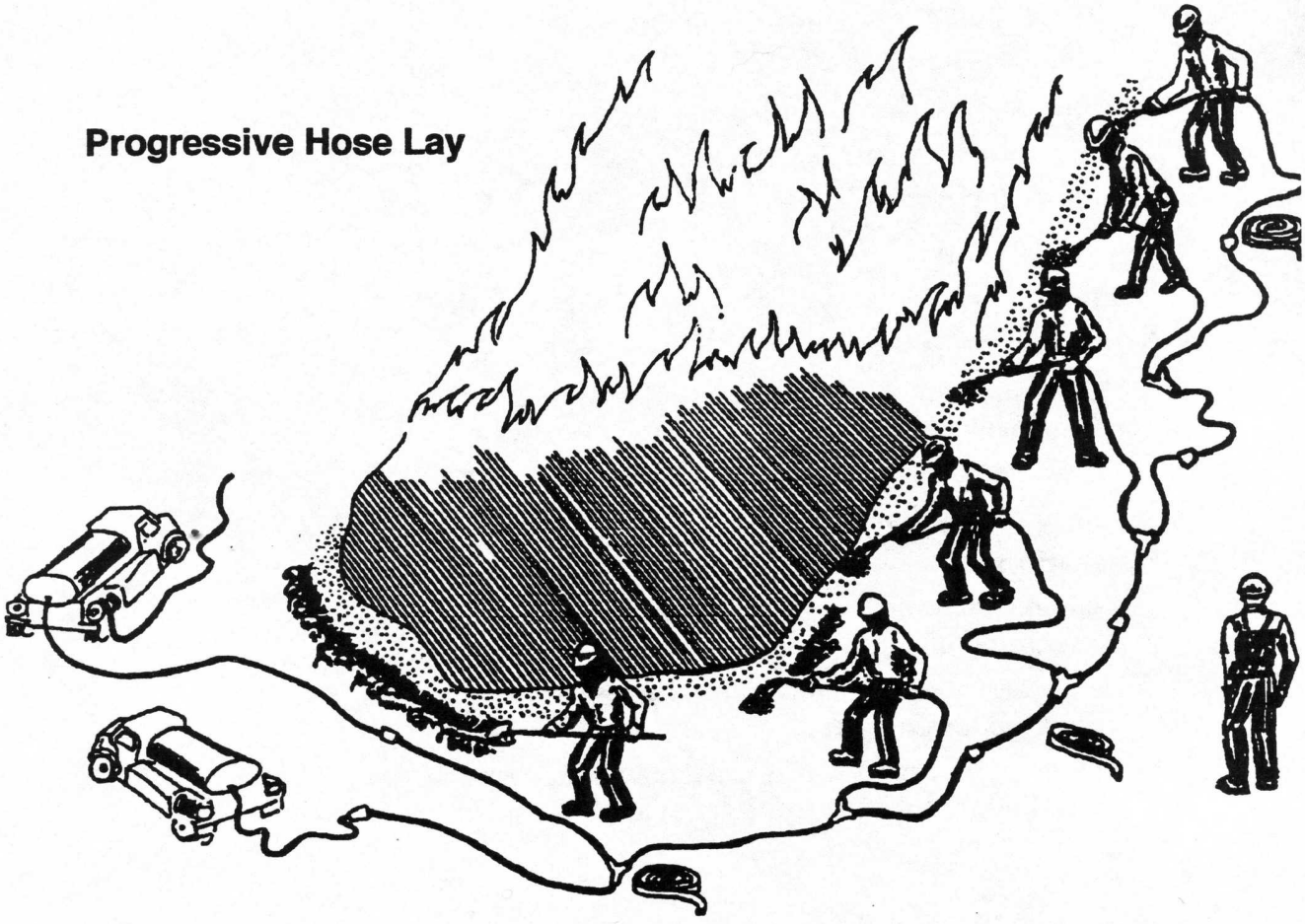
Advantages:

- Provides for a continuous attack on a fire without risk of shutting down the hose lay to extend its reach
- Provides a security margin for the lead nozzle operator; a charged or easily charged lateral line is behind the nozzle should a flare-up occur
- Provides quick deployment of lines on spot fires across the control line
- Supports effective mop-up

Limitations:

- Slower to install
- Creates higher friction loss in your hose lay
- Use of multiple nozzles reduces pressure and volume at each nozzle.

Progressive Hose Lay



Hose Lay Principles

- When laying your hose, protect the hose from hazards such as heat, engines, and traffic exposure.
- Friction loss will reduce your system's effectiveness over great distances.
- Increase your hose size over great distances to provide better pressure.
- Water should always flow from the female end of the hose to the male end (the male end should always be away from the pump).
- The largest diameter hose should be used first, near the pump.
- When using engines, install a reverse wye valve in the first length out from the engine; this permits the hookup of a second engine to supply more pressure and volume. It assures a continuous flow of water by allowing engines to alternate refill trips as they become empty.
- When the hose lay reaches the fire, a gated wye should be installed. It provides a place to fill a backpack pump, and it protects firefighters by providing a potential lateral line, should the fire flare up behind the nozzle. It enables a lateral line to work the fire while the main line is being extended, and it expedites the mop-up. A gated wye should be installed wherever a lateral is needed.
- Extra hose should be available at the leading nozzle, in case of hose breakage or a flare-up out of reach of the leading nozzle.
- In most cases, the hose line should be charged before attempting to attack a fire.
- All hose should be kept out of the burned area until the area is cooled by water.

Hose Deployment

The efficient deployment of hose is important to the wildland firefighter. Hose is generally laid in two ways, using rolled hose or prepacked hose.

Rolled Hose

Advantages: fire caches normally store and ship rolled hose, so there is no handling necessary prior to deployment. It is easier to store, ship, inspect, and test.

Disadvantages: difficult and slow to deploy. Rolled hose is hard to deploy uphill or through brush or slash and takes

both hands to unroll. This leaves the person laying hose without a tool.

Hose Packs

Rapid hose deployment is a method of readying your hose before an incident happens in an efficient pack for quick deployment on the incident scene.

- **Advantages:** deployment is four to five times faster than with using rolled hose. Firefighter's hands are free to carry a tool and help if climbing in rough terrain.
- **Disadvantages:** takes time to construct, but can be done before a fire starts. Hose packs must be repacked about every two months if not used, to reduce damage to the hose. They also should not be stored during the off-season but should be dismantled.

Three common types of packs are:

- Gansner hose packs
- Accordion packs
- Hose pack sack

Hose Retrieval

Once the hose lay operation is finished and it is time to retrieve the hose, it is important to follow the proper method to avoid damage to the hose.

1. Draining the water from the hose:
   - Open a valve or disconnect the hose at the lowest point on the line
   - Stretch the hose out to drain all the water.
   - Tie a knot or flagging in the end of hose on damaged sections.
2. Rolling hose: protect the male threaded end of the coupling by beginning the roll with the male end first. It should end up in the middle of the rolled hose.
3. Damaging hose retrieval practices include dragging it over hard, rough surfaces such as rock or pavement or pulling long lengths of hose by the fitting with vehicles, winches, and ATVs.
4. Hose rolling techniques include single, double, watermelon, and figure 8.

Hardware

Hardware on engines may include adaptors/reducers, strainers, hose clamps, spanner wrenches, ejectors, and gated wye valves.

Nozzles

Nozzles allow the firefighter to form and direct a stream of water under pressure at the fire. **The nozzle and the skill of the operator at the point of application often determines the degree of success in firefighting.** Water can be highly effective or largely wasteful, depending on which nozzle is selected and how it is used. The three types of water streams are:

Types of water Streams

Solid Water Streams

Solid water streams are used where the ability to reach, or the distance, is the key aspect in getting water onto a fire. Fire burning into a tall snag may require the additional reach a straight stream provides. A fire may be burning too intensely for the nozzle operator to work the fire's edge, or the nozzle may be needed in strong winds to direct the water delivery. It may also be needed to penetrate matted grass, needles, and duff.

Spray and Fog Streams

Spray and fog patterns offer the nozzle operator more effective application of water because of the small droplet size. These types of patterns provide protection from radiant heat and allow you to work closer to the flames.

Spray patterns are used extensively for close work along the fireline, working around other firefighters, or mopping up.

Combination Streams

Combination streams provide both straight and fog streams. Combination patterns are usually required in most wildland fire applications. Water streams must adjust to the conditions encountered along the fireline.

Types of Nozzles

The varying types of nozzles offer you the ability to make your selection based on rate of delivery (gallons per minute), pressure requirements, and a variety of water patterns, from solid streams to spray patterns to a fine fog.

Common types used for wildland applications can be broadly grouped as:

- **Twin-tip combination shut-off:** combination straight stream and fog pattern with shut-off (forester).
- **Adjustable combination:** adjustable sequence from shut off to straight stream or spray pattern.

Maintanance

Handle all nozzles with care. Avoid dropping, and when possible keep them out of the dirt. Check nozzles for obstructions or damage, full operation, threads in good condition, and gaskets in good condition. Clean filter screens and wash dirty nozzles and replace and tag defective nozzles.

Hose Systems

Hose Types and Construction

- **Braided:** nonwoven, high-pressure rubber hose (example hard line).
- **Wrapped:** rubber hose with a wire reinforcement (hard suction).
- **Woven:** continuous woven fibers in a circular configuration with no seams (cotton jacket, rubber lined).

Hose Care and Maintanance

Hose must be protected whenever and wherever possible from:

Mechanical Injury

- Abrasions, rips and tears, crushed and damaged couplings, and cracked inner linings.
- Avoid laying the hose over rough, sharp corners.
- Prevent vehicles from running over the hose. Provide warning lights and use hose bridges in traffic lanes.
- Avoid closing the nozzle abruptly.
- Avoid excessive dropping or dragging of the couplings.
- Change the position of bends in the hose line when reloading packs or trays. Avoid excessive pump pressure.

Heat Injury

- Heat can cause hose char, melt or weaken the fabric, and dry the rubber lining. Protect the hose from excessive heat or fire whenever possible.
- Use moderate temperature for drying.

- Hose that has not been used often should have water run through it quarterly; this prevents drying and cracking of the rubber lining.

Mildew and Mold

Bacteria growth will occur if hose is left damp after use; it will rot and decay the jacket.

- Replace all wet hose with dry hose.
- Use hose rack or tower to dry properly.

Chemical Contacts

Most rubber contains sulfur which, under proper conditions, can combine with water, air, and woven jacket materials to create sulfuric acid, thus weakening the hose.

Hose Washing and Storing

1. Wash and scrub all hose after each use. Use plain water or mild soap, if necessary. Clean and check couplings:
   - Submerge and scrub female coupling in soapy water
   - Brush and inspect male coupling
   - Inspect female gasket
2. Store only clean, dry hose. Proper storage includes:
   - Cool, dry, shaded, ventilated area.
   - Rotate stored hose with hose currently in service.
   - Hose that is in hose trays or hose packs should be removed and repacked at least quarterly if it has not been used.
   - Tag hose that is out of service.

Hand Tools and Firing Equipment

Pulaski: a hand tool with an ax and a hoe on opposite ends of the head. It is used for chopping, digging, and grubbing in the soil.

Point blade shovel: used for digging fireline, clearing brush, and throwing dirt onto a fire.

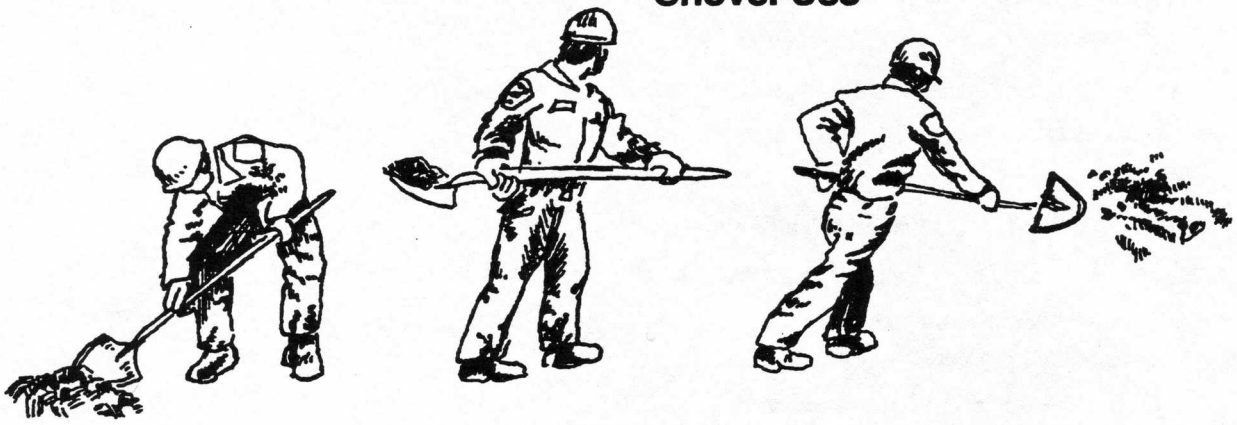
Safe practices for hand tools:

1. Check all tools before using them.
2. Keep handles tightly attached to the head.
3. Handles should be smooth and kept free from paint, oil, and grease.
4. Always keep your tool sharp.

5. Use your tool guard when you are not using tool.
6. Always wear gloves.
7. Carry tool on the downhill side of a slope.
8. Carry pulaski with ax end hanging down at your side.
9. Keep a working distance of 10 feet from other firefighters.

Pulaski Carrying and Use

Shovel Use

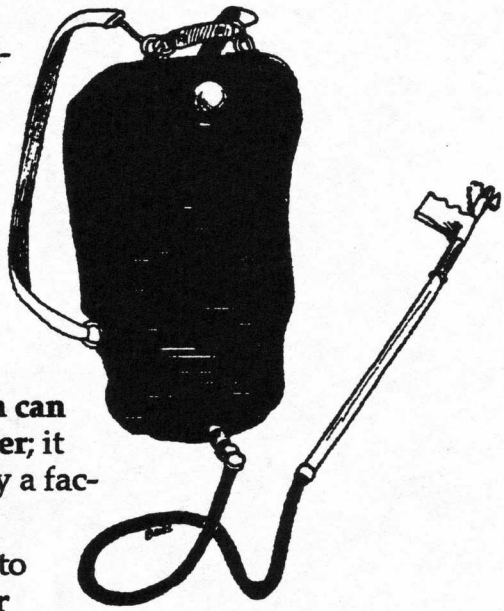


Spruce bough: a small sapling that is cut, lower branches removed, and used as a broom in a sweeping motion to smother fire.

Burlap bag: another type of smothering tool for low heat, small fuels fires. Burlap bags can be more effective when wet and filled with moss, mud or other burlap bags.

Swatter: thick rubber mat with a long handle, which allows you to fight fires with higher flame lengths. It is also used like a broom to smother fire.

Backpack pumps: also referred to as Fedcos or water bags. These fireline tools are used to remove heat.



- Parts: five-gallon (45 pounds when full) collapsible water bag with harness backpack. Removable metal cap, hand pump, and interchangeable nozzles (spray and straight stream).
- Filling: use hose, submerge in water tank, or use a hard hat to fill the bag. A filter (mosquito netting or cheesecloth) should be used to protect pump from becoming clogged with debris.

  A small amount (6 oz.) of Class A foam can be added to Fedcos to provide wet water; it increases water penetration into fuels by a factor of three.
- Operation: spray mode should be used to cool larger areas. Use straight stream for flames or to work long distances. Direct the spray at base of flames and get the nozzle in close to be most effective. Conserve water.

Chain saw: chain saw uses include cutting limbs, brush, and timber and making or improving firelines. It is the most dangerous hand tool firefighters use.

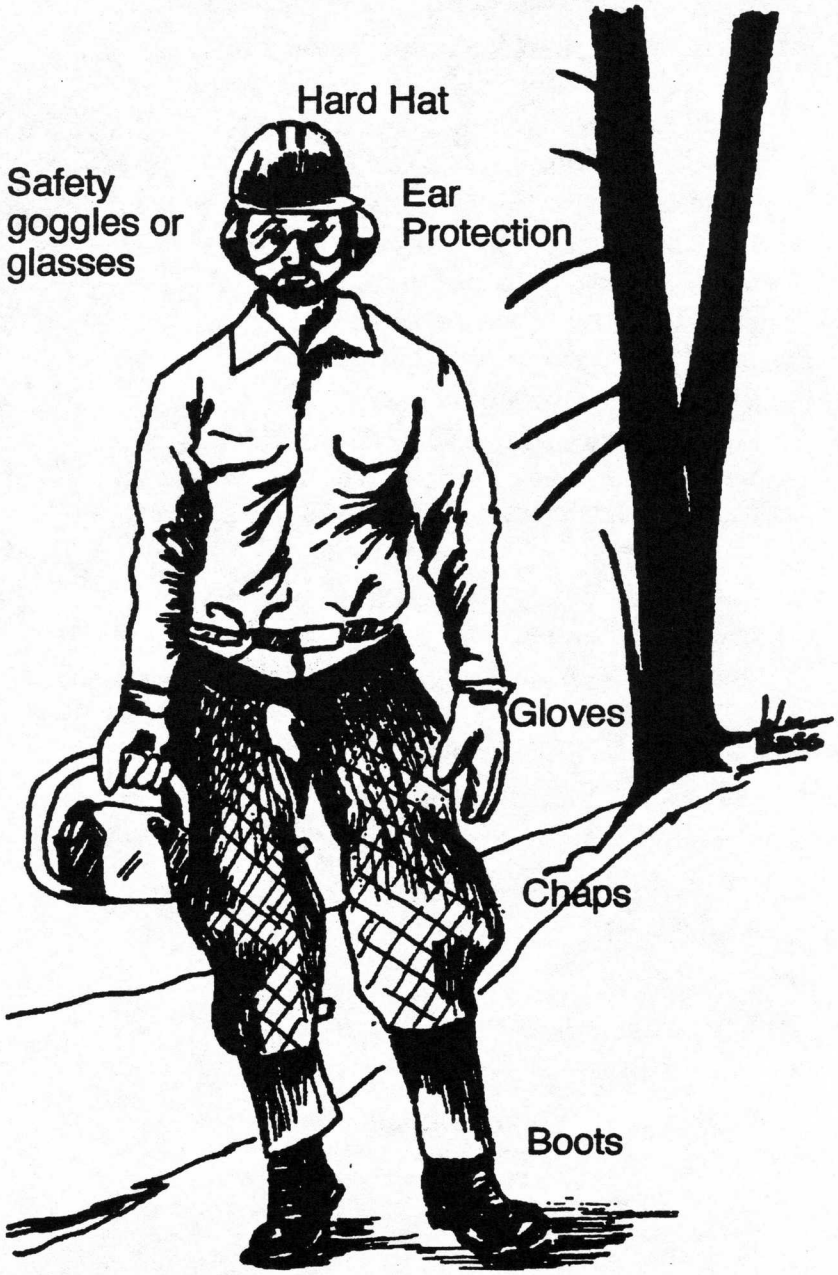
Safety equipment:

- Leg chaps
- Ear protection
- Eye protection
- Hard hat, gloves, and boots

Safe practices when using the chain saw:

- Carry the saw with chain guard on, at your side, bar to the rear.
- Wear gloves, even when sharpening chain.
- Always work with a swamper to help watch for danger and pull brush.
- Post a lookout when felling large trees.
- Clear all unnecessary firefighters out of the saw area.
- Never raise the chain saw above your head to cut.

Chain Saw Safety Equipment



- Always stop the engine for any maintenance.
- Wedges can help you avoid binding up your saw when falling trees.

Fusee: also known as highway flares, fusees are used to start backfires or to burn out fuels.

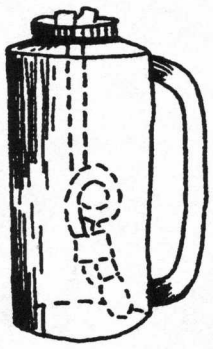
Safe practices include:

- Wear gloves and have sleeves rolled down.
- Wear eye protection.
- Strike the cap to the fusee down, using great care to avoid the eyes. Sparks can fly. Strike in a downward motion, away from face.
- Place the fusee on a short pole or stack fusees together for easier reach to ignite ground fuels.
- Be aware of wind direction. Fusee smoke is toxic.

Drip torch: A wick-fired canister of diesel and gasoline mixture used to start fires quickly.

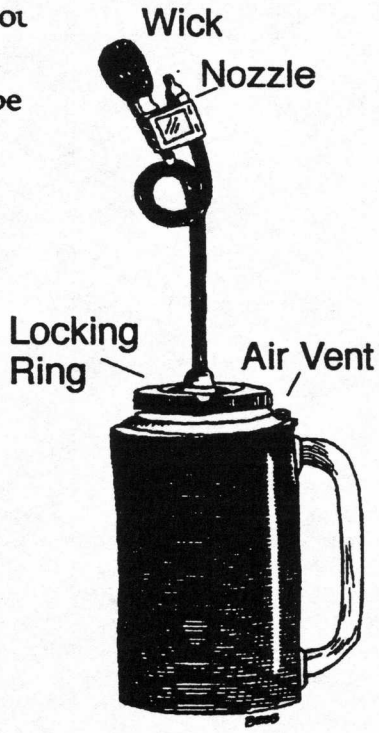
Safe practices include:

- Wear gloves and have sleeves rolled down.
- Proper mixture is 2/3 diesel, 1/3 gasoline.
- To store properly, seal the plug tight, lock with the ring tightly screwed on, air vent closed, cool the spout and wick and invert in tank.
- Don't light too much fire too fast. Burning should be performed by experienced firefighters only.



Drip Torch in Sealed Position for Storage

Drip Torch



Exercise 3-3: Is it important to keep your tool guard or sheath on your tool when it is not in use?

Unit IV
Strategy and Tactics

OBJECTIVES

Upon completion of this unit, trainees will satisfactorily identify:

1. Three incident priorities on any fire
2. The three phases of size-up
3. The concept of perimeter control
4. Seven principles of fireline construction
5. Three suppression methods that break the fire triangle
6. Two advantages of direct and indirect attack
7. Three methods commonly used to reduce hazards to a control line
8. Four effective mop-up practices

Points to Remember

Many studies have proven that human decision-making is imperfect at best. Add strees caused by an incident to the equation, and the firefighter's decision-making process really suffers. When responding to an incident, it is human nature to focus on the task at hand and get in the "hurry up" mode. Many serious accidents and deaths are cuased by the rescuer hurrying to get to the incident. You do no one any good if you cause an accident on the way to the fire by making poor decisions.

Lookouts, Communications, Escape Routes, Safety Zones

Resist the temptation to hurry. Concentrate on your training and experience. Stay in control of your emotions. Fire Order #9 states: "Retain control at all times." This means control of the people working for you and yourself. The most important thing you can do is stay calm and appear calm. As you approach the incident, formulate your strategic and tactical plans in your mind. Remember **lookouts, communications, escape routes, safety zones** for you, your people, and the public.

Command Sequence

All incidents are composed of a sequential order of four command decisions. They are **incident priorities, size-up, strategy, and tactics.**

Incident Priorities

What is the most important item to consider upon arrival at an incident?

1. **Life Safety**

   This primary mission includes the responders and the public. This is always your first priority.

2. **Incident Stabilization**

   To control and neutralize the emergency that you are responding to. This second priority must ensure that the actions taken properly address the problem(s) and that resources are used in a coordinated, safe, and effective way.

3. **Property Conservation**

   To prevent and limit damage to property.

4. **Environmental Protection**

   The protection of the environment from hazardous materials being released from the incident. Use the minimum amount of forces necessary to achieve the objectives.

Exercise 4-1: Explain the incident priorities in your own words.

Size-up

Size-up is an ongoing process of gathering information.

Before any action is taken on an incident, we first need to think. Size-up is where one makes the best determination as to what the problems are, based on the information we have available.

The three phases of size-up are:

1. **Preincident Information**

A wealth of information is available prior the incident. For wildland firefighting, this may include predicted weather, terrain, fuels, access routes, etc.

Exercise 4-2: What information do you have if a fire were to occur now?

2. **Initial Size-up**

A rapid, mental evaluation of various factors related to an incident:

- Identifying the problems. The first arriving crew must take the time to assess conditions calmly and to be proactive rather than reactive. Preplans and any other

preincident information should be used. It is also the first opportunity to identify any hazards present that may be a threat to the safety of firefighters or civilians.

- Where is it going? The head is generally considered the most critical part of a wildland fire. Once the head is contained, other parts of the fire usually are less difficult to control. Consider the intensity of burning and the rate of spread.
- How are the Big Three affecting the fire?
- Size of the fire. Size refers to the perimeter distance or area involved.
- Special hazards. Spot fires, the burn developing fingers, and proximity of flame to flash fuels.
- Exposures. Includes any property threatened by fire, such as structures, fences, power poles, and vehicles.

How do I control it? This question can be answered by identifying resources available and then using those resources in an effective action plan.

- Make use of streams, roads, cleared fields, swamps, burned areas, and other natural barriers.
- Access roads and trails. Consider these as possible routes, anchor points, barriers, and locations of command post.
- Water source. Consider supply route and the availability and location of streams, ponds, wells, and mobile tenders.
- Line of retreat. Use natural barriers as a guide and keep a means of retreat and escape open.

Risk-Benefit Evaluation

Fire fighting is a complex job and can be very dangerous with many related risks. All firefighter decisions on any incident must recognize the risks associated with the actions to be taken and must minimize or eliminate the risks as they are recognized. The **Ten Standard Firefighting Orders** and the **18 Situations That Shout "Watch Out"** must be followed at all times. Order #1 states: "Fight fire aggresively but provide for safety first"!

3. **Ongoing Size-up**

Size-up does not stop once the action plan is implemented and firefighters are taking action. Size-up needs to be ongoing throughout the entire incident, since unknown events will change the plan.

Strategy

The actions we take to address the problems resulting from the size-up should be based on a plan. The plan should first define **what** has to be done to solve the problem. Firefighters refer to this as strategy. Strategic objectives consist of broad goals that constitute an overall plan to control the operation. These goals should be achievable, reasonable, and measurable.

Tactics

Tactics are specific, measurable functions to meet the strategic objectives. Tactics are also defined as **how** objectives are accomplished at an incident.

Fireline Construction

Fireline is any control line that is used to stop a fire from advancing. A fireline may be a wet line, hand line, dozer line, or a retardant line.

Perimeter Control

The method used to attack wildland fires revolves around **perimeter control**. The control line may be established at a burning edge of the fire, next to it, or at a considerable distance from it. The objective is to establish a fireline that completely encircles the fire.

Some general principles for building fireline are

- Start lines at secure anchor points.
- Go around heavy fuel concentrations or beat the fire to them.
- All lines are tied together.
- Use natural barriers as fireline.
- Lines are wide enough to stop the fire.
- Burned fuels on the black side of the line, unburned fuels on the green side.
- Remove aerial fuels to the line standards.
- Make firelines as straight as possible.

Construction Techniques

Breaking the Fire Triangle

Removing Fuel

- **Removing fuel.** Removing fuel in the path of wildfire prevents the fire from spreading. A slowly advancing fire burning sparse ground fuels may be checked by constructing a fireline down to mineral soil. A fast-running fire may require several fuel removal operations: felling trees, cutting dry brush, and removing logs and low-hanging limbs. This does not extinguish the fire, but by constructing a fireline you remove fuels from the fire's path. Hand and dozer lines can accomplish this.

Process of Hand Line Construction

1. The crew boss or strike team leader flags the fireline to be built.
2. A saw team of a sawyer and swampers takes the lead, clearing trees.
3. Crew members with hand tools follow to cut and dig trench.
4. When a firefighter overtakes the next one (gets too close to work safely), he or she calls out to "bump-up." Firefighters working in front then move up.

Removing Heat

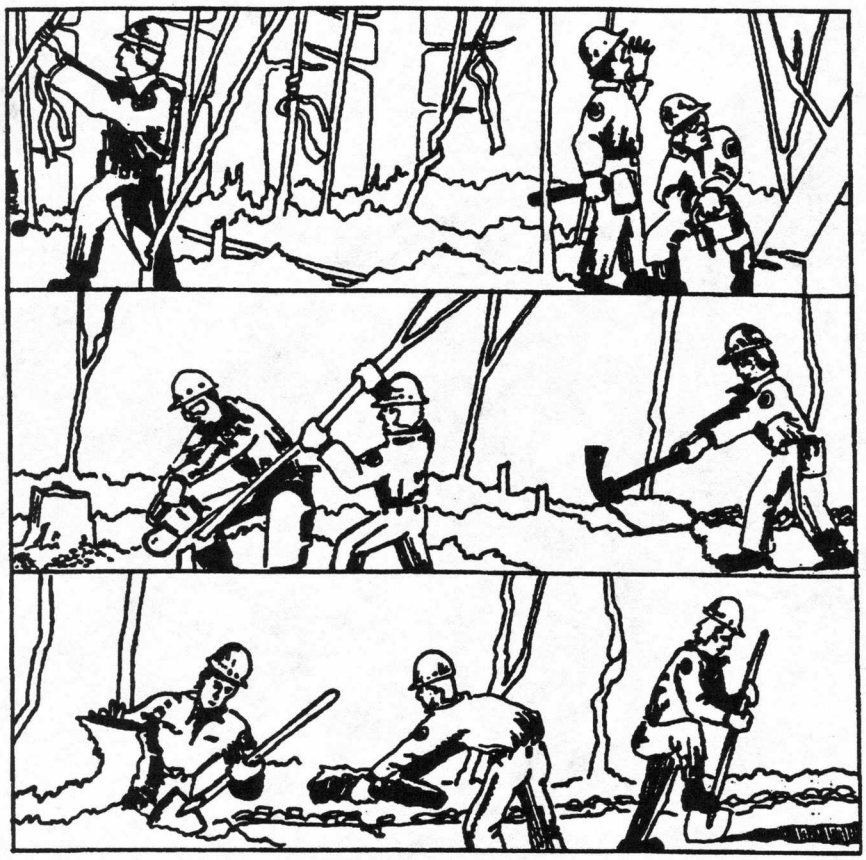
- **Removing heat.** A common method used by firefighters who have an adequate water supply. Reducing heat on wildfires may be accomplished by cooling with water or cooling with dirt. Wet lines and retardant lines remove heat.

  The use of water along a fireline helps to quickly suppress a wildland fire. Always conserve water when possible. Water supply may be limited and should be used wisely. Precautions for using water on a fireline include:

1. Shut off nozzles while traveling between flame areas.
2. High-pressure water may scatter burning fuel.
3. The volume should be kept at the lowest setting that will do the job and be effective.
4. Nozzles should be operated as close to the burning fuels as is practical.
5. An independent water supply and delivery system should be considered if access problems occur.

Removing Oxygen

- **Removing oxygen.** In unconfined wildland fires, it is difficult to completely shut off the supply of oxygen. If water is used, a fog nozzle should be considered to knock down the flames. Fog performs a smothering function on the flaming gases by occupying air space with millions of finely divided particles of water. This smothering action



can be further accomplished by foam. Soil, burlap sacks, and spruce boughs smother a fire and retard combustion.

Exercise 4-3: Fill in the blanks.

Key elements of establishing a perimeter are _____, _____, and _____.

Direct Attack

Direct attack is action taken along and directly at the edge of the fire to cool, drown, smother, beat out, or starve the flames of an active fire. As the term implies, the control line is constructed along and directly at the edge of the fire. This can be done using personnel, engines, or dozers.

Direct attack is used:

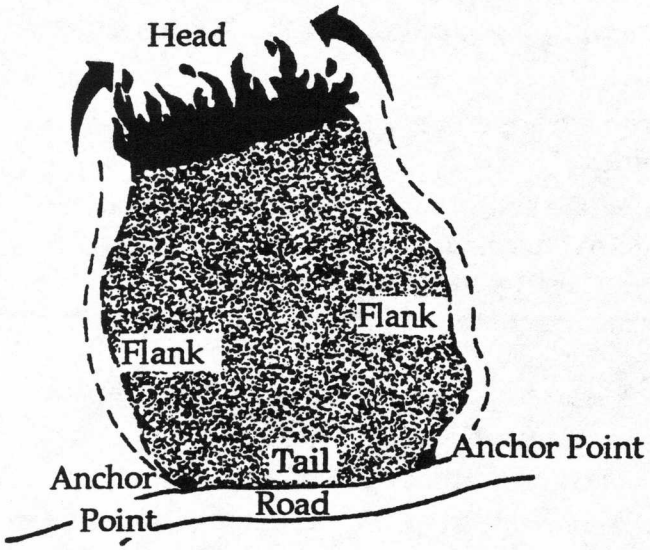
- On small fires with less than three-foot flame lengths
- In lighter fuels
- On the flanks and tail of larger fires
- Where burning intensity, heat, smoke, and terrain will allow this method of attack

Breaking the Fire Triangle

Types of Direct Attack:

- **Pincer action**: direct attack around a fire perimeter in opposite directions, using two or more attack units.
- **Tandem:** direct attack along a part of the fire perimeter by resources following each other.
- **Multipoint attack:** attacking key or critical segments around the entire fire perimeter at approximately the same time.

Pincer Method of Direct Attack



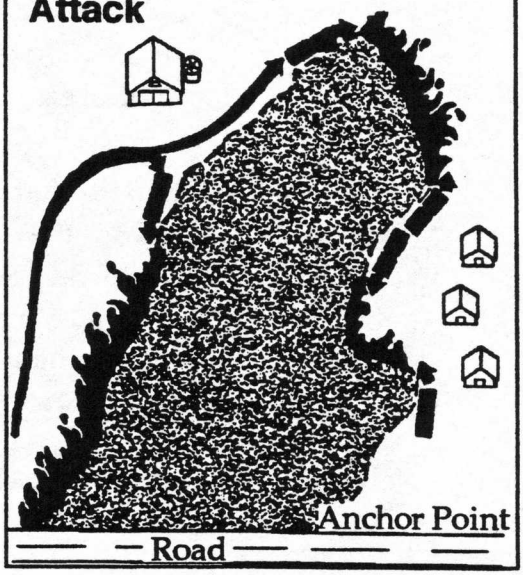
Tandem Direct Attack

Watch Out Situation

#10: You are attempting a frontal assault on a fire.

- Don't attempt to take on more fire and smoke than you can handle. If you are attempting this with an apparatus, make sure you have plenty of water.
- Stay together with your crew and don't get cut off from your escape route.
- Take immediate action on all spot fires over the line and keep good communications.

Multipoint Direct Attack



Direct attack strategies:

- Take advantage of wind lulls.
- Time the attack to coincide with fire entering into lighter fuels.
- Work as a team. Water and hand tools are most effective when working together.

Watch Out Situation

#16: You are getting frequent spot fires across your fireline.

- Don't become trapped between two fires. Know your escape routes.
- Take immediate action to suppress these new fires. Request help if necessary. Let adjacent forces and supervisors know of your situation.

Indirect Attack

Indirect attack is used when the fire is too hot to approach. Instead, barriers are established to control the fire from a distance. The fire is allowed to burn into a natural or man-made barrier, or backfiring is used. Laying down retardant from aircraft or applying Class A foam to stop the fire can also be considered indirect attacks. The advantage of the indirect attack is less exposure to direct heat, flames, and smoke. There is also more time to coordinate between attacking forces.

Backfiring is indirectly attacking a wildland fire by intentionally setting fire to fuels located inside the control line to reduce the fuels and help contain a rapidly spreading fire. Backfiring provides a wide defense perimeter and may also be used to change the force of the fire's convective column. Backfiring is usually a last ditch effort to stop the main fire, and it covers large areas and great distances.

Watch Out Situations

#8 You are constructing a fireline without a safe anchor point.

- Scout your fireline behind and ahead of your crew. Check behind you for rekindling. Check the fire ahead to anticipate fire behavior. Be sure the fire has not spotted across the line and that spot fires have not cut other firefighters off.
- Start your fireline at a natural barrier, road, or in light fuels that you can burn out.

#11 There is unburned fuel between you and fire.

- Stay alert for crowning and spotting.

- Know where your safety and escape routes are.
- Stay in voice or eye contact with supervisors.
- Consider burning out.

#12 You cannot see the main fire and are not in contact with anyone who can.

- Keep good communications with nearby firefighters.
- Review maps and weather and fire behavior forecasts for your assigned area.

Line Improvement

Once the fireline is constructed around the length of the fire, line improvement is the process of removing additional fuels or heat to strengthen your controlling edge.

How to Make Safe and Secure Lines

Standards to make the fireline as safe and secure as possible are:

- Progressively widening the black line by mopping up from the fire's edge.
- All snags, burning or unburned, that are close to the constructed line should be felled as soon as possible. Snags are a safety problem to personnel and equipment.
- A cup-trench, V-trench, or roll trench can stop material from rolling downhill.

Exercise 4-4: What other improvements could you make to improve the fireline?

1.

2.

3.

4.

Burnout Operations

Burnout is used when attack on the wildland fire is direct, or parallel with the control line, intentionally setting fire to unburned islands of fuel inside the control line to strengthen the line. The control line is not said to be complete until all fuel is "burned out" to the extent that no fuel remains between the fire and the control line.

The fuels that remain between the main fire and a fireline are burned out to ensure the safety of firefighters and the security of control lines. This gives rise to the concept that "the only safe line is a 'black line.'"

Contained Fire

Contained fire: a fire that has completed control line around it and any spot fire associated with it. The lines might not hold under foreseeable conditions.

Controlled Fire

Controlled fire: fire with control lines secured. All hot spots along the line have been extinguished and all lines are expected to hold under foreseeable conditions.

Patrolling and Mop-Up

Patrolling line includes watching for spot fires and preventing hot spots from crossing over the fire control line.

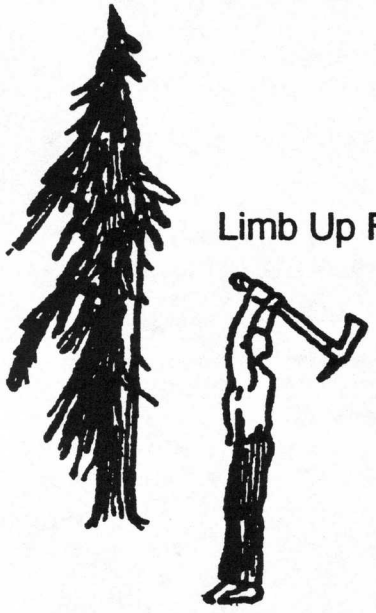
Patrolling the Line

- Hike the line in squads or teams of two, with hand tools and full backpack pumps.
- Look for spot fires.
- Look for gaps in the line.
- Improve areas such as wet lines that are drying out, sharp corners in the line, heavy concentrations of fuels, and places where there was an incomplete burnout.
- Work the hottest areas first, working in from the outside edge.

Mop-up

Mop-up can be compared to the overhaul phase of a structure fire. Mop-up begins as soon as the first piece of a control line is constructed. However, the task of mopping up the fire is usually not assigned as a specific responsibility until the forward progress of the fire has been controlled. It involves removing burning material from along the fire control line and extinguishing all hot areas. Mop-up is the most important phase of fire suppression to prevent reburns. A reburn is when a small spark or flame is left along the control line that rekindles the fire, causing all previous work to be lost.

The Progression of Mop-up to Strengthen a Control Line



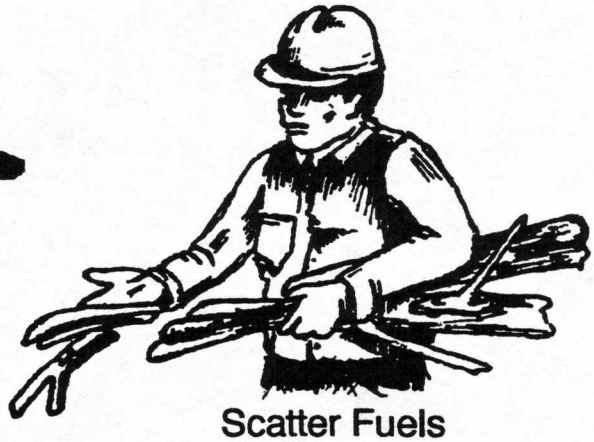
Limb Up Fuels

Break Apart Stumps

Make Trenches Where Needed

Fall Snags as Needed

Dig Out Roots



Scatter Fuels

Mop-up is effective when water and hand tools are used working as teams. Tools should be used to rake, chop, scrape, and dig out hot fuels, and water should be used to cool these fuels.

How to Find Hot Spots

How to find hot spots during mop-up:

- By sight: visible smoke, white ash, clouds of gnats, heat waves, steam
- By smell: sniffing for smoke
- By hearing: listening for the hissing of steam or crackling of embers
- By touch: feeling with the bare hand, called **cold trailing**

Wet Mop-up

Wet mop-up: teams of two using water and hand tools together.

- Usually faster and easier.
- Conserve water if the only water available is in the backpack pumps.
- If there is water for a pump, use hose lays and nozzles to deliver water.
- Unless you use tools to mix the water with the hot material, it may not put them out.
- A capful of Class A foam added to a full backpack pump increases water penetration threefold.

Dry Mop-up

Dry mop-up: using hand tools only, no water.

- Slower, more difficult.
- Easiest in the cool of the day or in the shade.
- Crew works as a group in hot areas or splits up into squads as needed.
- Pulaskis chop and mix small fuel particles with cooler or frozen dirt.
- Squads work together to pile and burn large fuel pieces.

Exercise 4-5: List the effective mop-up practices.

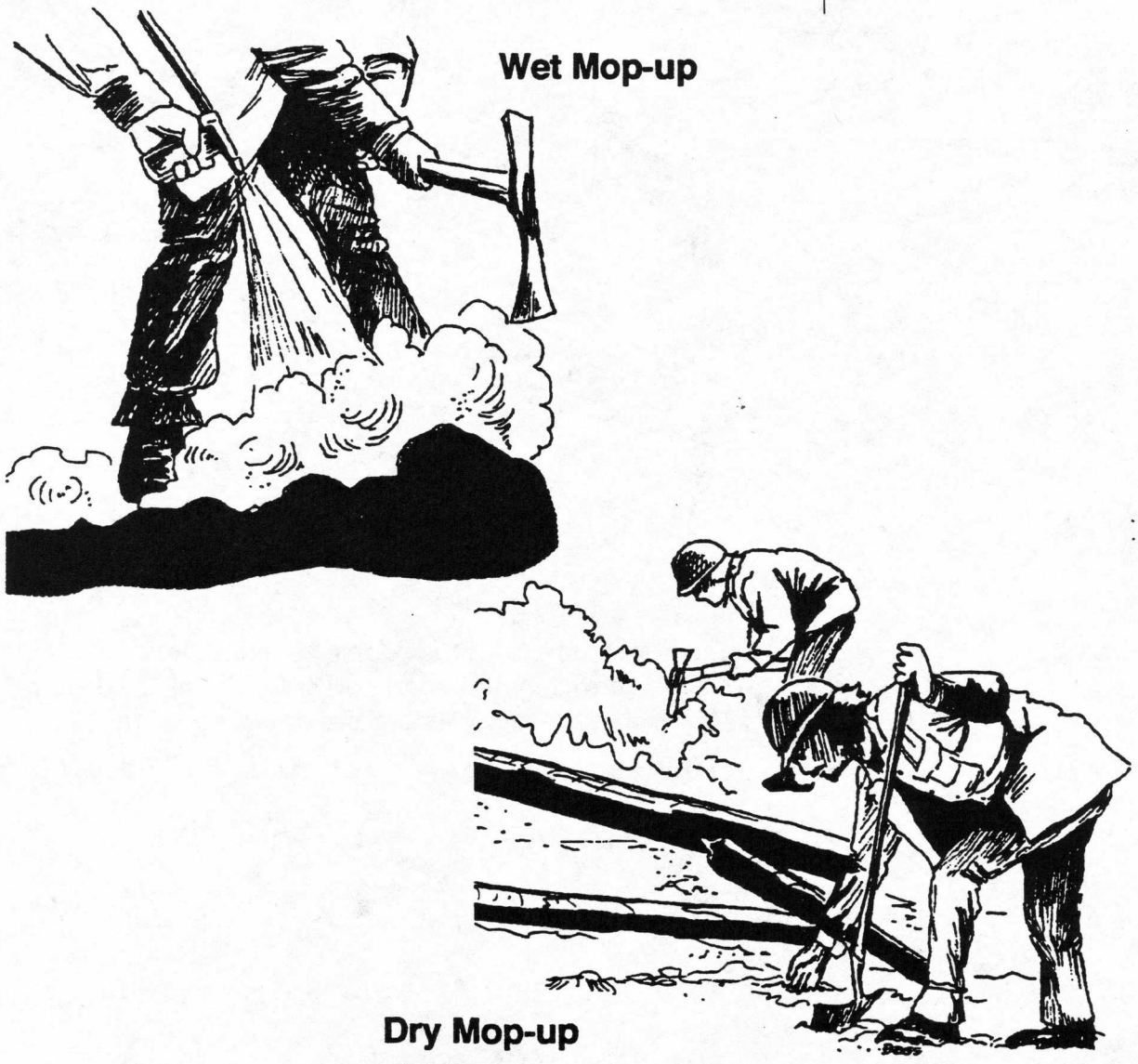
1.

2.

3.

4.

5.



Wet Mop-up

Dry Mop-up

Fire Crew Gridding

Gridding

Initial mop-up starts on the edge of the line. It then progresses inwards equally along all sides. Final (grid mop-up) is 100% mop-up of the whole fire or a piece of it.

The most important smoke on the fire is the last one.

Rehabilitation

Rehabilitation is an important part of the fire suppression effort. Its purpose is to restore the area where crews and equipment have worked to a natural condition as much as possible. Fire control activities should not cause more damage to the forest ecosystem than the fire itself.

- Construct water bars and diversions to reduce the force and amount of water moving down steeply sloped firelines.
- Replace the vegetative mat layer, dirt, and rocks in trenches built in hand line construction.
- Clear out sump sites, dams, and crossings made in streams.
- Clean up any areas where you have made shelters or fire pits or left garbage.

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Unit V
Structure Defense

OBJECTIVES

Upon completion of this unit, trainees will satisfactorily identify:

1. Define triage
2. Three structure triage categories when confronting fire in the urban interface
3. Five factors upon which you base your triage decisions
4. Three factors that can cause electrocution from power lines
5. Five considerations on engine placement during interface fire operations
6. Three methods to minimize a structure's outside ignition potential from a wildland fire
7. Three methods to minimize a structure's inside ignition potential from a wildland fire
8. The concept of defensible space
9. Three types of hose lines used in structure defense
10. The concept of prelaying hose lines
11. Three effective uses of water application during structure defense
12. Four conditions that may mean the situation is hopeless

Structure Triage

Structure triage is the prioritizing of structures that require protection from wildfire. Triage could be required of any firefighter at any time in the incident.

The goal of triage is to do the most good with what you have and to **not waste limited resources or time.** It requires you to quickly prioritize threatened structures as:

- Needing little or no attention for now
- Needing protection but saveable
- Hopeless

Look at the greatest potential threat, based on the assumption that the fire behavior will be the worst possible scenario under the prevailing conditions. While you may not base your actions on such a possible threat, at least have an alternative plan should the worst develop.

These factors will affect the triage decision and will be the basis for the structure defense tactics once the decision is made to protect a structure.

Factors That Affect Your Triage Decision

Firefighter Safety

You are the most important person.

Stress and Heart Attacks

- Firefighters who are not physically fit to fight a wildland/urban interface fire should not be on the fireline.
- Wearing structure protective equipment on a wildland fire increases the threat of heat stress.

Power Lines

Downed power lines start many fires and are a common hazard at most interface fires. A call to the local utility should be your first call on a suspected power line fire or any time live wires are suspected on any fire.

- Beware of fires at night where a downed power line could be the origin. First responders have been killed fighting these fires. Proceed with extreme caution.

Exercise 5-1: What Watch Out Situation applies here?

- Stay clear of the area near wires.
- Treat any power line as if it is charged.
- Protect other firefighters and the public by posting a scout and by flagging off this area.
- Don't park or fuel apparatus underneath power lines.
- Don't touch a power line with a ladder, antenna, or straight stream of water.
- Clear the area underneath power lines of all personnel during an aerial retardant or bucket drop.

Hazardous Material

Fuel tanks. Try to remove the tanks from the fire area or protect the fuel tank from direct flame impingement. Fuel lines may be the first to burn as they are made from a less fire-resistant material.

Pressurized vessels. Propane and other compressed gas in containers will normally vent if the temperature exceeds a certain point. If this occurs, do not stop the venting. Try to protect the tanks from sustained heat. **Qualified personnel should remove all explosive materials away from a building.**

Clear fuels from around such hazards to a distance adequate to protect them from excessive radiant heat, or remove them to a safe area. The required clearance will depend upon fire intensity and your ability to cool or shield them.

Stay out of reach of toxic gases from homes and outbuildings. These gases can cause serious injury in a short amount of time. Limit your exposure to wildland toxic gases by staying upwind, out of the smoke as much as possible. Wearing a handkerchief across your nose and mouth can help.

Engine Placement

Routes into your defense area may be blocked by heavy fuels, by limited access, or by being too steep to safely drive. Many structures threatened by wildland fire will not be conveniently situated on a wide, paved street. They may be at the end of long, narrow driveways opening off of rural lanes and flanked by flammable vegetation.

Getting into and out of the structure area requires care and planning. Going in may be easy; leaving the fire in zero-visibility smoke may be more challenging.

- When approaching your area, pay attention to landmarks and hazards. Mark your route in or escape routes with flagging if necessary. Note potential safe zones.
- **Back the engine into position** from the last known turn-around.
- The engine should be positioned to make it safe and convenient to work from.
- Do not block access for other equipment or evacuating vehicles. Park off the road.
- Do not park over flammable vegetation. Scrape or burn away the fuel from your parking place if you need to.
- Park on the side of the structure that minimizes the engine's exposure to heat and blowing firebrands. Avoid parking where septic lines, septic tanks, and root cellars might be located.
- Be near enough, but not right next to, the structure to limit the length of hose lines.
- Avoid parking next to or under such hazards as power lines, flammable trees, fuel tanks or pressurized vessels, or buildings that might burn.
- Leave the doors closed and the windows rolled up. You don't want to find your seat on fire.

Pets and Livestock

Most animals that are free to move around will manage to avoid being burned. However, if they are fenced or chained, they may need to be set free. Troublesome or frightened pets could be placed in the garage, residence, or other enclosure.

The Structure

Is the structure susceptible to fire? Note the construction features and condition they are in. The size and shape of the building and its position on the lay of the land will affect your triage decision.

Roof

The roof is the most ignitable part of a structure exposed to a wildland fire.

Remove any debris (leaves, grass, etc.) on the roof and in the rain gutters.

Look at the roof materials and the access provided by the pitch in sizing up the roof.

Siding

Look at the siding of the building. Is it flammable?

Heat Traps

Heat traps are areas that will funnel into, and concentrate, heat and embers. Gables that are open, vents without screens or with non-fire-resistant screens, and overhanging decks and awnings are examples.

Any entry of fire or firebrands into the structure greatly increases control problems and the likelihood that the structure will be damaged or destroyed. **Concentrate your efforts on the openings on the most exposed side of the structure.** Openings on the less exposed sides may need attention but are less of a priority. Here are some openings that you will probably have to deal with:

- Vents and ducts that look intact. Large-mesh screens need to be covered. Use whatever can be nailed or propped over the hole that is not easily ignited.
- Windows should be closed and screens attached. Even if windows are intact, it is worth covering them to keep them from being broken by heat or hose streams. Use plywood, sheet metal, or other flat panels.
- Large openings such as doorways or breezeways are hard to cover. Sheets of plywood, tarps, and salvage covers can be used.

Interior Structure Preparation

Interior structure preparation includes:

- Remove light curtains and easily ignited materials (such as paper) from the vicinity of windows. Drapes that are of readily flammable material should be drawn back or taken down.
- Close nonflammable window coverings such as blinds or shades and drapes.
- Close interior doors to limit fire spread should the interior become involved.
- Turn off fans or anything that blows air.
- Turn off the gas at the source.

- Leave electricity on to run pumps, provide lighting, etc. (Note: if the interior becomes involved with fire, you should turn electricity off for safety.)
- Illuminate a porch light and a central interior light to provide visibility in dark, smoky conditions. Patrolling engines will more easily notice the house, and firefighters entering it will have some light.
- Make sure essential doors can be opened if interior attack is needed.

Fuels

Fuels are anything that will burn. Look at the surrounding fuels at the structure site, including fuels that could produce spot fires. Are there items such as vehicles, pipes, and poles scattered around the yard that could create control problems, pose hazards, or have a value worth protecting?

Yard Accumulation

Yard accumulation can interfere with the placement and movement of hose lines. Accumulation can also greatly complicate and delay firing operations. Remove all possible yard fuels to a protected location. Break the direct contact of objects like woodpiles and fences with the structure. Clear or burn out around those objects that are impractical to move.

Vehicles remaining on site should be taken care of so that minimal damage occurs, and they should not interfere with firefighter operations.

- Park them in a sheltered location, away from heat and firebrands.
- Make sure they will not interfere with the movement of fire equipment.
- Do not park them over flammable vegetation.
- Park the vehicle headed out with the keys in the ignition.
- Close the doors and windows, but do not lock the vehicle.

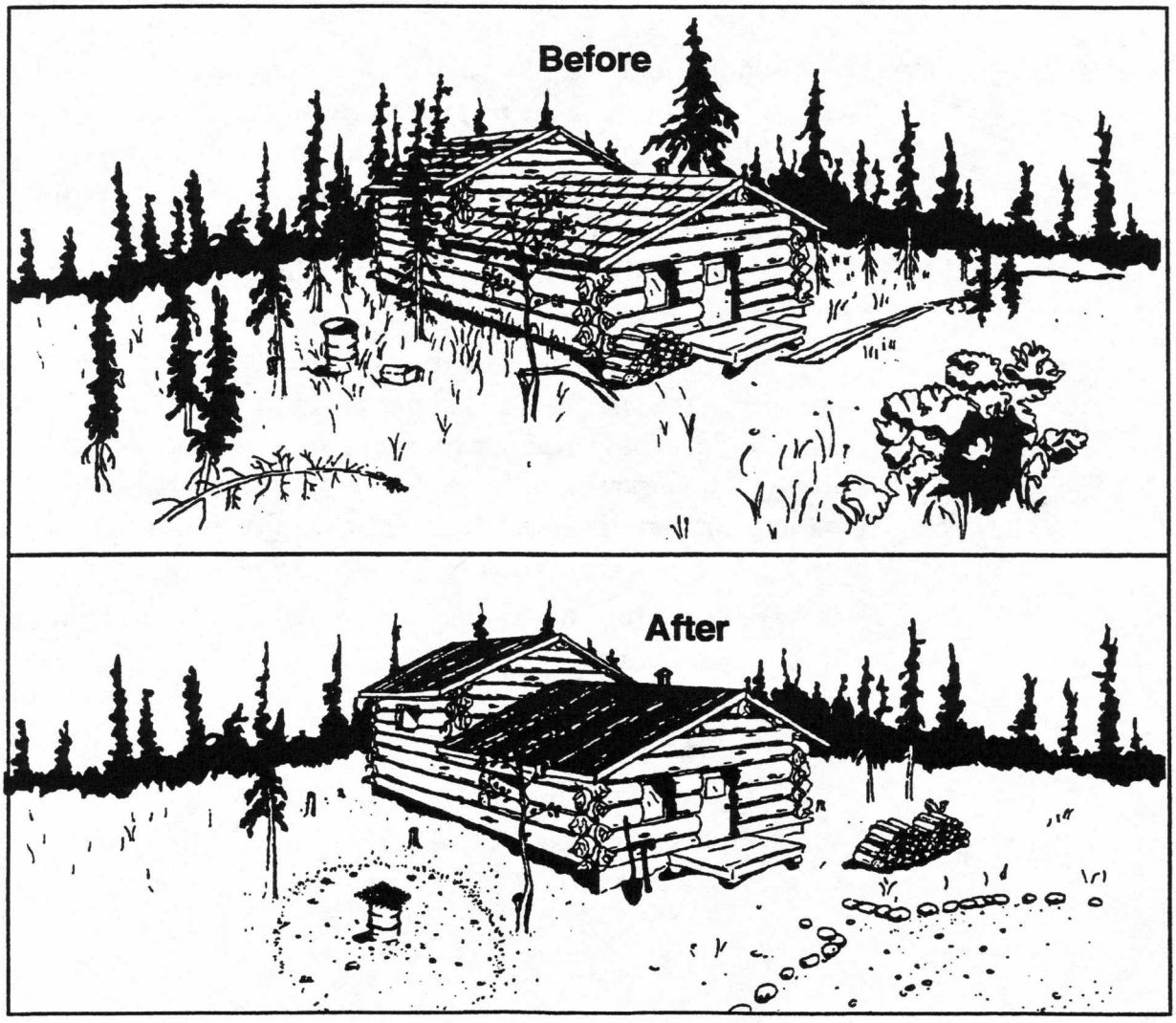
Defensible Space

Defensible space is the desired fuel clearance surrounding the structure that will inhibit fire spread. The width will depend upon the intensity of the wildland fire. As a general rule, the clearance should be at least **two to three** times the length of the anticipated flames.

Enough clearance is needed to allow firefighters to operate around the structure. If steep slopes or strong winds drive the fire hard toward the structure, it must be wider.

Remove and trim flammable vegetation from the zone around the structure. To provide a clear zone two to three times the flame length, the vegetation producing those flames must be removed or broken up. Vegetation producing shorter flames only needs to be removed to the smaller clearance. Therefore, grass will require a lesser clearance than brush or timber. Remove ladder fuels.

Put cleared vegetation where it will not burn or will not cause a problem if it does. Simply felling trees or lopping off branches and leaving them may create a more flammable fuel bed than you had before.



Exercise 5-2: What kind of fuel reduction work would you perform around your home?

Fire Behavior

Will the fire entering your defensive area smolder, creep, run, torch, spot, crown, or blow up?

- Rate of spread: where is the head of the fire? Is there spotting or firebrands? What are the flame lengths? Smoke may hamper visibility.
- Topographic influence: what is the aspect and slope? How will that influence fire intensity and behavior?
- Weather influence: what are the winds, temperature, relative humidity?

Fireline Construction

Fireline should be placed in fuels and terrain where you can control the main fire or your burn-out operation. It should be placed as close as possible to a nonflammable zone (for example the lawn) or to the structure. If flammable vegetation that could carry fire to the structure remains inside the control line, firebrands could still ignite a fire that reaches the structure.

The primary control line may need to be placed well away from the structure to handle the main fire. If flammable and receptive fuels surrounding the structure remain a problem, you may need to conduct a secondary firing operation to clean up fuels. That might require a second control line close to the structure.

Take advantage of existing natural barriers in the fuel. Such breaks include:

- Roads and driveway
- Lawns and landscaped areas
- Driven-on or trampled grass
- Power line right-of-ways
- Trails or paths

Look for things that you can use to help prepare the structure and fight the fire:

Resources

- Building materials for covering openings in the structure (plywood, boards, sheet metal, etc.)
- Hammers, saws, nails, wire, etc., for securing coverings.
- Rakes, brooms, blowers for removing leaves, needles, or grass.
- Ladders to gain access to roof

  Use the homeowner's ladders if possible. Position them for easy access to the roof, a good vantage point. Some extension ladders can be taken apart to provide separate ladders. The extra ladder could be used for an upper roof, another building, or as alternate access to the same roof. When putting the ladder in position, try to accomplish the following:

  1. Put it on an unexposed part of the building away from the worst of the heat and smoke. It should be usable when the fire arrives at the structure.
  2. Leave it visible so that anyone who comes along and needs quick access to the roof will notice it.
  3. Minimize the distance a hose line would need to be brought from an engine in order to be taken to the roof.
- Locate residential water sources, including wells, holding tanks, hot tubs, lakes, ponds, rivers, streams, etc.

Interface Fire Operations

The hose lines and nozzles you decide to employ have to be large enough to handle the anticipated fire intensity. At the same time they cannot be so large that your water supply will be spent too quickly.

Hose Lines

The lines you lay out or have readily available must adequately cover the structure, including the roof, yet still leave you a safety line for your engine.

Exercise 5-3: Fill in the blanks with the names of the hose lines described below.

A. _____

A good choice for this line is 1 ½" or 1 ¾" hose. These provide an adequate stream while being reasonably easy to handle.

If you are certain you can manage the highest anticipated fire intensity, then lines of ¾" or 1" provide a very mobile and reliable choice. One disadvantage of hard line is that it cannot be rapidly cut off and abandoned without real damage.

Deploy two lines, one around each side of the structure or around a pair of adjacent structures. Lines must be long enough to meet behind the structures. (Try to do it with no more than 200 feet of line). Lines laid out this way allow two

streams to be directed at hot spots and flare-ups, a backup if one line fails, and the fire to be split up and led around the sides of the structure.

Attach the lines to the same side of the engine and to outlets that have a shut-off valve at the engine. This will allow the lines to be rapidly disconnected if a retreat is necessary.

Lead the lines behind the engine and not in the exit path. You do not want to wrap them around a wheel if you leave in a hurry.

B. _____

Lines should be readily available for use on the roof or in the interior of the structure. Such lines can be stretched to a ladder or to an entry door or left on the engine, ready to be advanced quickly.

Any interior line should be 1½" to 1¾". The roof line, intended primarily for quick action on small fires, can be hard line or garden hose. If the roof becomes well involved, heavier lines will be needed. Any line positioned for immediate use should be charged and checked.

C. _____

A line should be provided for the protection of the engine and crew. It may be needed if fire overruns your location or if you must drive out through the fire.

A length of hose long enough to reach around the engine can be loosely coiled or folded on top of the engine. It must be easily reached and quickly charged by the crew. Make sure it will not fall off if the engine is in motion.

D. _____

In some cases lines can be laid before an engine actually takes up a position. For example, a unit carrying only hose could precede the engines and place hose lines to be used later.

Prelaid lines should be left so that they are easily noticed and within reach of the outlets on an incoming engine. Possibly mark them with flagging.

Do not leave the couplings where they might be run over. You can drape the ends of the lines over a fence, mailbox, limb, etc.

Techniques of Water Use

Water Supplies

Wise water use is critical to the success of structure defense efforts! Water is usually in short supply.

Rural water systems are commonly of low capacity or nonexistent. Even good supplies were not designed to handle dozens of structure fires simultaneously, not to mention the wildland fire. All too often power failures shut down water system pumps.

Try to save a 100-gallon reserve in your engine. That water is for your engine and crew if you are threatened or need to escape.

Take advantage of any opportunity to add water to your tank. Run a garden hose in your tank while you are parked. Refill at hydrants if possible.

Peak heat wave tactics:

The passing front of a wildland fire can be compared to a wave of heat. As the wildland fire approaches, heat and firebrands will increase.

During the peak of the heat and smoke, it is very tempting to squirt water at the wall of flame, hoping that it will somehow improve things. But that will probably do little good and will waste water. Wetting down the fuels and the structure prior to an oncoming fire is **usually a waste of time and water.** In the face of winds, low humidity, and fire, the wetted surfaces will soon dry out and be susceptible to ignition. Water is more effectively used on actual fire when it can significantly reduce the heat or extinguish the fire.

To escape the radiant heat, seek refuge in the shade of something that blocks it. Duck around behind a wall, stay below the roof peak on the sheltered side, or hide behind an object. The duration of the peak heat wave depends upon the fuels involved and the burning conditions.

In light fuels such as grass, the flame front will pass a given point in a minute or so. It will generally move past the structure in no more than a few minutes.

In brush or medium type fuels, burnout times are longer and spread rates are often lower than for grass under similar conditions. The fire may take 10 to 15 minutes to move past the structure.

Crown fires in timber can generate intense heat that may last a considerable time at any location. Whatever the fuel, if the fire is burning sporadically, the duration of the heat wave near the structure is prolonged. The peak heat intensity will be reduced since fuels are not consumed as quickly.

To summarize, when the fire is controllable, limit the heat build up by keeping fire out of heavier fuels. Work on the fire where it has moved into lighter fuels. At the other extreme, wait until the worst of the heat passes, then put water on the structure or on threatened fuels. In between extremes, apply water if it significantly reduces the heat impinging on the structure.

Foam

One method of water application is suited for pretreating structures: the use of foams. The Class A foam coating more thoroughly uses the water contained within it to absorb heat. When foam is correctly applied and allowed to build up on wildland fuels (including structures), it excludes the air from the fuel and envelopes the volatile combustible vapors at the fuel surface. Class A foam also absorbs the heat of combustion and releases water from its bubble structure slowly.

Foam clinging to the sides of fuel tanks and pressurized containers will cool them and protect them from direct flame contact. If flammable liquids or other hazardous materials are involved with fire, vacate the area, report it, and allow firefighters trained in hazardous materials to handle the situation.

Class A foam should not be confused with Class B hydrocarbon foams. It should not be used on flammable liquid fires.

Exercise 5-4: List the benefits of foam in wildland firefighting.

Confronting the Fire at the Structure

Full Containment Around the Structure

Consider the following four general situations. The situation may change in the course of the fire.

Cut off the fire before it reaches the buildings, essentially at the outer edge of the yard.

- Use water or hand tools or let it burn into a fuel break.
- Such fires might be burning in light fuels and not be driven hard by wind or slope.

If you can't wait for the main fire or if the fire will be too intense for direct control, consider burning out from a control line.

Full Containment

Partial Containment Around the Structure

It may appear that only partial containment is possible. You may be able to modify or diminish the fire as it hits, but the fire will move past the structure before you can establish control.

- Use your working lines to knock down the part of the fire front that is moving directly toward the structure.
- Burn out from a short section of control line to take out the most threatening segment of fire front.
- When you have split the fire front, use your working lines to lead the fire on around the structure.
- Put out any fire remaining on the fringes.
- Check the structure thoroughly for fire. Remember the common ignition points.

Partial Containment

Spotting Potential

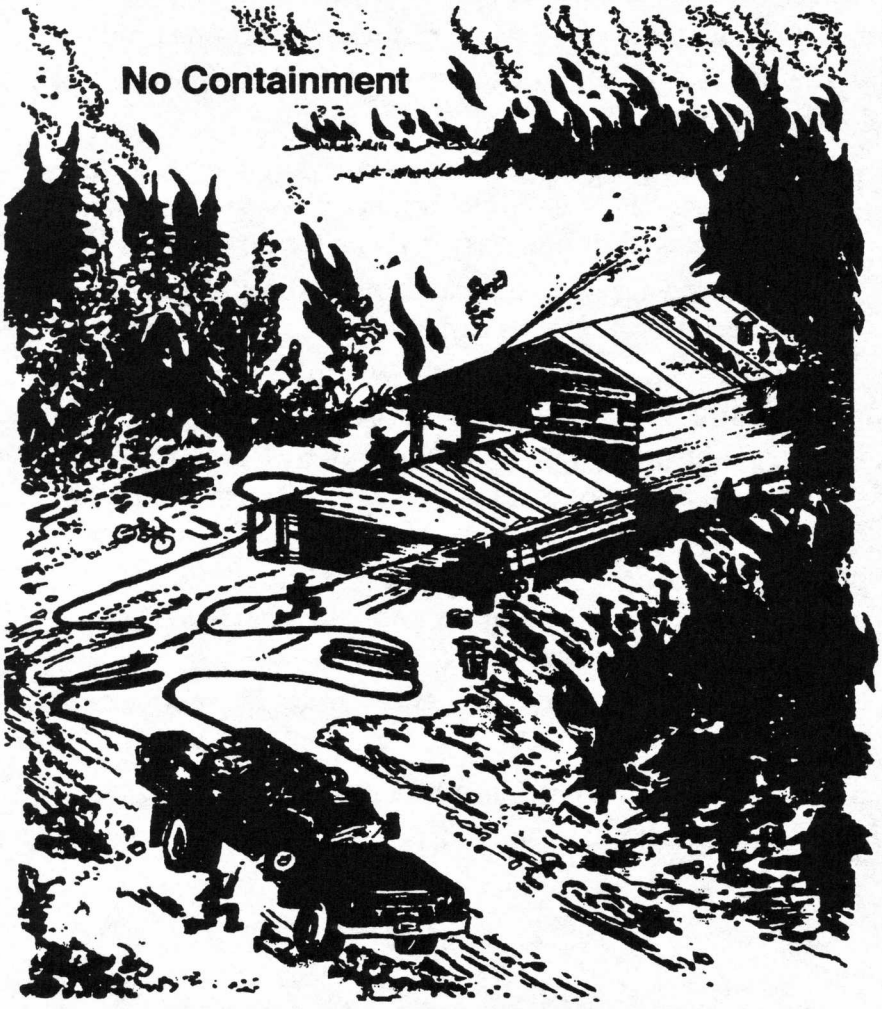
Firebrands are the major problem in the spotting zone. The threat may exist for several hours (putting you in a different situation), or it may never get there. Firebrands may ignite new fires a mile or more ahead of the main fire.

- Remain mobile enough to quickly reach any point within your area of responsibility.
- Hose line deployment may not be necessary, except to actually put out a spot fire.
- Constantly check for new ignitions; this is not a time to relax your vigilance.
- Watch prime receptive fuels such as roofs and woodpiles.
- Patrol as necessary and post lookouts (with communication).

If a spot fire occurs, attack it quickly. Make sure it is completely out or has a good control line so the fire cannot spread. Remain alert for other spots at the same time.

No Containment Around the Structure

If no containment is possible and the wildland fire will move through essentially unchecked, your efforts will have to be directed at the structure. Direct all hose lines onto the structure and allow the wildland fire to burn past. If the fire intensity threatens your safety, retreat to a safe zone and re-enter the area when the fire has passed. **A structure's defensible space may be the crew's safety zone. Also you must consider that retreat out of this protected space may be impaired by fire, smoke, and other associated hazards.**



Exercise 5-5: List three wise water practices during structure defense.

1.

2.

3.

After the fire has passed by the structure

After the fire has passed, structures that are left standing need to have a perimeter established around them to prevent them from being destroyed later by hotspots. They need to be patrolled and constantly checked until a secure perimeter is established around them and there is no extension into the building from blowing embers

When Is It Hopeless?

No simple rule will tell when to try or when to abandon a structure defense effort. Listed below are some factors or conditions worth noting. If any of these conditions apply, the attempt to save that structure deserves careful consideration before continuing.

- The fire is making significant runs (not just isolated flare-ups) in the larger live fuels (brush or tree crowns). The structure is within one or two flame lengths of those fuels.
- Spot fires are igniting on and around the structure and growing faster than you can effectively put them out.
- Your water supply will not allow you to continue firefighting until the threat subsides.
- You cannot safely remain at the structure and your escape route could become unusable (blocked by fire, traffic, falling or rolling obstacles, etc.).
- The roof is more than one quarter involved with fire, in windy conditions, and other adjacent structures are threatened or involved.
- Interior rooms are involved and windows are broken.

In summary, if things change or if you are losing the battle, rethink your plan. The situation depends on a decisive best judgment and good effort.

Unit VI
Safety and Survival

OBJECTIVES

Upon completion of this unit, trainees will satisfactorily identify:

1. Five safe practices around helicopter operations
2. The Standard Fire Orders
3. The 18 Situations That Shout "Watch Out"
4. Four elements of fatal or near-fatal incidents on wildland interface fires
5. Four survival techniques in an interface fire
6. Five procedures for successful fire shelter deployment

Aircraft Safety

Wildland firefighters rely heavily on aircraft support. Rotor and fixed-wing aircraft provide firefighter transport, water and retardant delivery, aerial firing, supply, reconnaissance, and communication support.

Helicopter Operations

Helicopters are commonly used for point-to-point delivery on wildland fires. The larger the helicopter, the more turbulence it creates.

1. Proper boarding and exiting

   Safe areas to walk on and off helicopters are to the front and sides of the aircraft where the pilot can see you. **Always stay away from the tail rotor.**

2. Proper distance
   - Stay at least 60 feet away from a helicopter approaching to land.
   - Be aware that as the helicopter approaches, a wind is generated by the rotors that can exceed 50 miles per

hour. Lighter objects not tied down will blow away or be sucked into the rotors. Be sure to weight down or tie light objects properly. Nearby hot areas can flare up. Fire can escape control lines because of helicopter rotor wash. Wear safety glasses.

- Noise levels exceed all safe levels and inhibit all normal conversation. Wear appropriate protection for ears.
- Plan for an approaching rotor craft by establishing good communication with the pilot and all ground personnel before the helicopter arrives.

3. No smoking

   No smoking is allowed on helicopters or around fueling areas.

4. Side hill approaches

   When a helicopter is sitting on an uneven pad or a side hill, approach and exit in full crouch and from the downhill side. Keep low and be aware of rotor height.

5. Pitot tube

   This tube is part of the airspeed indicator and contains a heating element inside. Don't touch the Pitot tube as it can burn you severely. It protrudes off the nose of the aircraft. Watch that you don't walk into the Pitot tube.

6. Carrying tools

   Carry tools flat and low. A tool carried over the shoulder could strike the rotor system. Never throw anything near the main rotor as it could be sucked into the blades and thrown quickly down in any direction.

7. Loading considerations

   Air operations personnel should direct loading. Tools and passengers do not ride together in the same compartment. Tools should be loaded in proper balance and secured in the cargo area. Never place sharp tools under seats in the passenger cabin. If safety questions arise, ask your pilot.

8. In-flight safety

Exercise 6-1: List the personal protection gear necessary to fly on fire-related duties.

9. Tail rotor avoidance

   Get in the habit of never approaching a helicopter from the rear. Whirling rotors are invisible and deadly.

10. Helicopter bucket use

    Water from an externally loaded bucket is an effective firefighting tool. The bucket is attached via a steel cable; the pilot controls the opening and closing of the bucket doors.

    Safety considerations around the drop zone:

    - Stay clear of the helicopter, the drop zones, and the flight approach area.
    - Be aware of the rotor wash and what it could do to your fire.
    - Buckets can separate from the aircraft.

1. Propellers

Fixed-wing aircraft have propellers that are much like rotors in their ability to create an airfoil. Treat them the same way, with extreme caution and safety awareness as listed above. Most fixed-wing aircraft have propellers located in the front, low to the ground.

2. Retardant drops

Chemical retardant and foam agents are mixed with large amounts of water to form a mixture of retardant. This liquid is delivered to the fire by large cargo planes at low altitudes (100 to 1,000 feet above ground level) and significant speeds (100 to 200 m.p.h.).

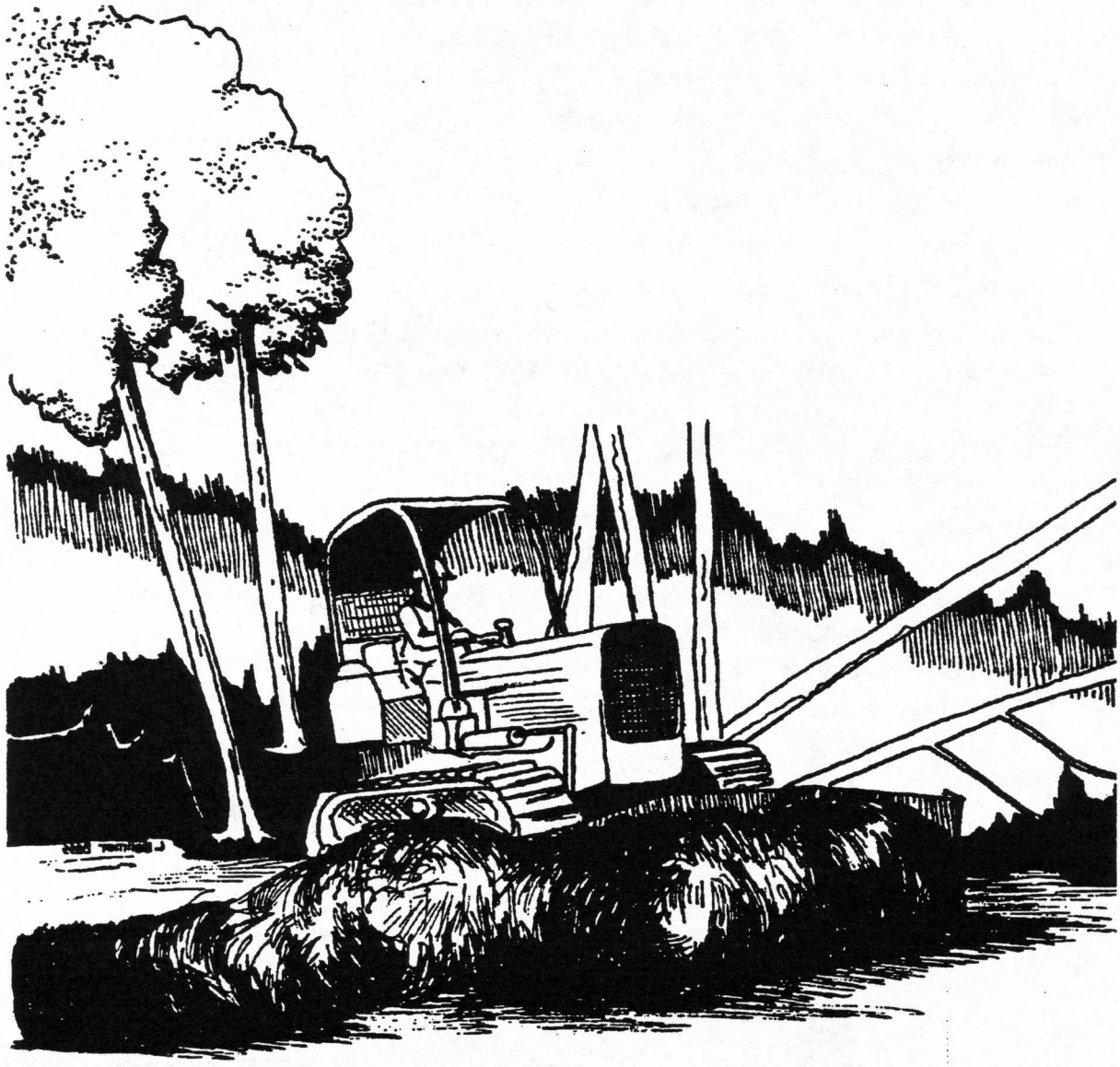
Hazards Around the Drop Zone

Extensive damage will occur in the retardant drop zone from the force of fluid impact.

- Be aware of when and where a retardant aircraft will be working in your area. Stay clear and inform others to stay clear.
- Be aware of the potential of wind gusts arising from low-flying aircraft and what that could do to your fire.
- Be aware of all improvements, including power lines.
- If you are in the path of a retardant drop, shield yourself if possible with structures, the apparatus, or large immovable objects. Discard all light objects, including hand tools. Lie down facing the aircraft with your hand over your hard hat.

Safety Around Heavy Equipment

Heavy equipment can include earth-moving machinery that builds fireline or machinery that carries water to an incident. Heavy equipment can produce loud noise, which makes communications difficult. Foremen or line locators can help in coordinating communication. Yield to tonnage. Give heavy equipment lots of room. The larger the machinery, the farther firefighters should operate from it.



Ten Standard Firefighting Orders

Wildland firefighters continue to suffer serious injuries and fatalities that can be prevented if proper actions are taken. The ten standard fire orders define the proper actions.

1. Fight fire aggressively but provide for safety first.
2. Initiate all action based on current and expected fire behavior.
3. Recognize current weather conditions and obtain forecasts.
4. Ensure instructions are given and understood.
5. Obtain current information on fire status.
6. Remain in communication with crew members, your supervisor, and adjoining forces. Stay together with your crew.
7. Determine safety zones and escape routes.
8. Establish lookouts in potentially hazardous situations.
9. Retain control at all times.
10. Stay alert, keep calm, think clearly, act decisively.

Exercise 6-2: Can you describe the three general areas that the standard firefighting orders can be broken down into?

Situations That Shout "Watch Out"

Wildland firefighters continue to suffer serious injuries and fatalities that can be prevented if proper actions are taken. The 18 Situations That Shout "Watch Out" are intended to increase emphasis on avoiding situations and conditions that have resulted in fire shelter deployments, serious injuries, and fatalities.

1. **Fire is not scouted or sized up**
   - Communicate with other engine crews and line personnel.
   - Keep your crew together.
   - Be aware of escape routes and safety zones.

2. **You are working in country not previously seen in daylight.**
   - Hazards increase in nighttime because of poor visibility.
   - Keep good communications.
   - Wear a head lamp if venturing into the darkness.

3. **Safety zones and escape route are not identified.**
   - Always be aware of their location, especially if burning conditions change. Ask your engine foreman or strike team leader if in question.

4. **You are unfamiliar with weather and local factors influencing fire behavior.**
   - Keep alert for changes in wind speed and direction, and inform everyone when you notice something different.

5. **You are uninformed on strategy, tactics, and hazards.**
   - Ask questions of other firefighters and supervisors. Obtain a briefing from your supervisor. On project fires, read the incident action plan.

6. **The instructions and assignments are not clear.**
   - Ask for explanations if the assignment doesn't seem to relate to the strategy and tactics.

7. **There are no communications links with crew members and the supervisor.**
   - Keep in constant communications with other firefighters working together, and let someone know where you are going if you take independent action.

8. **You are constructing a fireline without a safe anchor point.**
   - Scout your fireline behind and ahead of your crew. Check behind you for rekindling. Check the fire ahead to anticipate fire behavior. Be sure the fire has not spotted across the line and that spot fires have not cut other firefighters off.
   - Start your fireline at a natural barrier, a road, or in light fuels that you can burn out.

9. **You are building a fireline downhill with active fire below.**
   - A dangerous situation because of the probability of convective heat blow up. Know where your escape routes and safety zones are. If building fireline downhill, place scouts to constantly monitor the fire behavior and the weather factors that could change fire behavior.
   - Expect and look for spot fires up slope. Be aware of rolling rocks and logs up slope.

10. **You are attempting a frontal assault on a fire.**
   - Don't attempt to take on more fire and smoke than you can handle. If you are attempting this with an apparatus, make sure you have plenty of water.
   - Stay together with your crew and don't get cut off from your escape route.
   - Take immediate action on all spot fires over the line and keep good communications.

11. **There is unburned fuel between you and fire.**
   - Stay alert for crowning and spotting.
   - Know where your safety and escape routes are.
   - Stay in voice or eye contact with supervisors.
   - Consider burning out.

12. **You cannot see the main fire and are not in contact with anyone who can.**
   - Keep good communications with nearby firefighters.
   - Post lookouts.

13. **You are on a hillside where rolling material can ignite the fuels below.**
   - You can be trapped between the main fire and spot fires. Make sure the line behind you is patrolled.
   - Keep aware of safety zones. Move into a burned section if no other place is available.
   - Dig cup trenches that will hold rolling logs, and turn logs so they will not roll down slope.

14. **The weather is getting hotter and drier.**
    - Be alert for increased fire spread and longer flame lengths.
    - Expect more spot fires and increased heat along the fireline. Make sure these areas are out before leaving them.
    - Know your escape routes if the fire blows up.
    - Make sure you have enough drinking water, and use your suppression water wisely.

15. **The wind increases or changes direction.**
    - Be alert for increased fire spread and longer flame lengths.
    - Make sure you can see the fire or post scouts who can. Look for increased spotting, firebrands, smoke, or other indicators of strong, shifting winds. Be aware of convective thunderheads.

16. **You are getting frequent spot fires across your fireline.**
    - Don't become trapped between two fires. Know your escape routes.
    - Take immediate action to suppress these new fires. Request help if necessary. Let adjacent forces and supervisors know of your situation.

17. **The terrain and fuels make your escape to safety zones difficult.**
    - Know where the fire and your safety zones are at all times. If your zone to safety becomes threatened, consider evacuating immediately.

18. **You feel like taking a nap near the fireline.**
    - Fatigue is a reality. When you stop for a rest break near a fireline, post a lookout.

Fatal and Near-Fatal Fires

Similarities have been identified by evaluating past tragedy fires. By recognizing these common denominators, firefighters can identify potentially deadly situations and take the appropriate steps to ensure their safety and that of co-workers.

Exercise 6-3: List the four common denominators on fatal and near-fatal fires.

1.

2.

3.

4.

Survival Techniques if Trapped by Wildland Fire

In some instances, there may be no chance to avoid fire. Avoid the temptation to panic. If fear becomes overwhelming, judgment is seriously impaired and survival is a matter of chance.

When entrapment is probable without your protective fire shelter, injuries or death may be avoided by:

- Do not run blindly or needlessly. Unless the path of escape is clearly indicated, do not run. Move away from the flanks of the fire, traveling downhill where possible. Conserve your strength.
- Enter the burned area. Do not delay. If escape means passing through the fire front into the burned area, do so when flames are less than three feet deep and you can see clearly through them. Cover exposed skin, hold your breath to protect your lungs, and move through the flame front quickly.
- Burn out. If unable to enter the burned area, find an area of light fuels, ignite it and step into this burned area as it cools. Cover as much of your exposed skin as possible. This action will not be effective in heavy fuels that burn for a long time.
- Regulate breathing. To avoid inhaling dense smoke, take shallow, slow breaths close to the ground.
- Protect against heat radiation. Shield yourself from the heat rays by seeking a shallow trench, crevice, large rocks, bodies of water, vehicles, or buildings. Cover exposed skin with dirt.
- Lie prone. In an emergency, lie flat with head down on an area that will not burn. Chance of survival is greater in this position than if overtaken by fire when standing upright or kneeling. You will rarely outrun a blow-up fire situation.

Survival Techniques if Trapped by an Interface Fire

Many of the survival techniques listed in this section regarding taking refuge in a structure or engine are also rescue and evacuation procedures when protecting the public.

Take Refuge in the Structure

- The structure won't burn instantly, and it provides protection from the fire outside. Mobile homes burn rapidly and should not be considered a place for interior protection.

Take Refuge in Your Engine

- Find a safe location and stay with the vehicle.
- Keep the pump running and use the looped 1 1/2" line to deploy a fog pattern over the cab.
- If available, take self-contained breathing apparatus into the cab and use it as necessary to protect yourself from smoke.
- Use fire shelters, coats, blankets, or salvage covers to reflect radiant heat from the windows.
- Roll up windows and close vents.
- Request air support for retardant or water bucket drops.
- Stay inside the cab until you are sure it is safe to go outside. If the motor has died, there is not enough oxygen outside to keep you running either. If the engine is catching on fire, so will you if you go outside. Get on the floor. The cab will normally burn last and may buy you time until things outside start to cool down.
- If the temperature rises, cover your face with a dry cloth.
- A vehicle parked away from heavy fuels may be the best place to survive an entrapment. Metal gas tanks and containers rarely explode.

If you leave your engine, park it in as safe a place as possible, perhaps in the garage.

Rescue and Evacuation Procedures

It takes time to move people to safety, and it takes a safe location to move them out of danger. If you have neither time nor a location, consider leaving people in their homes until the fire storm passes. Rescue can be a choice of removing the fire from the victims or removing the victims from the fire or a combination of both. Request evacuation help from local police authorities. Firefighters can help to accomplish rescue by providing the following:

- Assist those who are evacuating on their own.

- Evacuate those who are nearest to the fire.
- Evacuate areas ahead of the fire.
- Try to move those trapped into an area where they can be protected from the radiant heat.
- Move those people who are in an open area to a location with the least amount of combustibles. You may have to burn out an area to provide further protection.

Fire Shelters

Design and Deployment

All wildland firefighters must carry fire shelters as part of their safety equipment. The fire shelter is their last line of defense.

The fire shelter was designed in the early 1970s to reduce fire exposure and radiant heat. It is constructed of commercial-grade aluminum foil over fiberglass cloth, bonded by a nontoxic adhesive capable of withstanding temperatures of 1,400 degrees F.

1. It is most effective in light fuel types, where thermal outputs are low and rate of spread high. Heavy fuels or equipment stored next to a shelter will exceed 1,400-degree temperatures.
   - Remove as many fuels as possible from the area of deployment: four feet by eight feet.
   - Scrape fuels down to mineral soil beneath shelter.
   - When selecting safety zones or natural barriers, avoid areas of heavy fuels where crowning behavior could occur.
2. The fire shelter's shape resembles a low-profile pup tent, with interior straps.
   - These straps allow the firefighter to physically hold the shelter down during high winds.
   - Forms an airspace between the foil and body to take advantage of cooler temperatures near the ground.
3. Avoid deployment areas such as ridge lines or saddles. Turbulent winds and thermal outputs are likely to exceed the firefighter's ability to survive and hold down the shelter.
4. Deploy shelter with feet towards oncoming fire front. The aluminum skin of the fire shelter may get very hot, so keep it away from the body. Expect tremendous noise and wind turbulence as the fire approaches.

5. Do not attempt to take hand tools and equipment inside the shelter with you. Do not store chain saws, fusees, or fueled equipment next to shelter deployment areas.

Inside the Shelter

Firefighters should be wearing fire-resistant clothing, hard hat, and gloves.

- Communications via talking loud or on your radios can give needed moral support.
- Resist breathing into a wet cloth, as moist air will increase lung damage. A dry cloth over the face with short, shallow breaths next to the ground is best.
- **Drink as much water as possible.** Don't drink excessively hot water. Remember, you are trying to stay hydrated, but your airway and lungs must be protected from heat.

Temperatures inside the shelter may reach 150 degrees during a peak heat wave.

- Resist panic; you can survive these temperatures inside your shelter.
- If movement is necessary, (wearing gloves) stand up in shelter, deflect heat with the shelter, and move to a cooler position.
- Plan on several thermal pulses. Do not leave the shelter too early. Many successful deployments have lasted nearly an hour.
- By lifting up a corner occasionally, you can keep the shelter relatively free of smoke.

Cuts and tears in the shelter should not cause panic or undue concern. Although more smoke and heat will enter the shelter, it will still provide you with enough thermal protection to survive a heat wave.

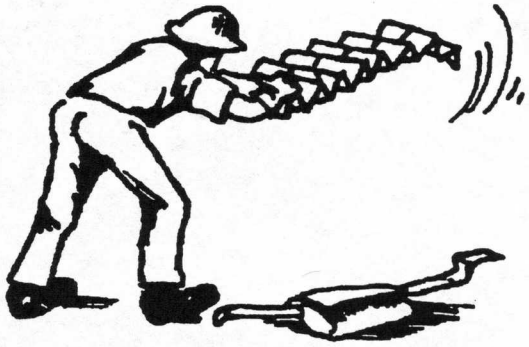
Exercise 6-4: List the five procedures for a successful fire shelter deployment.

1.

2.

Deploying a Fire Shelter

1



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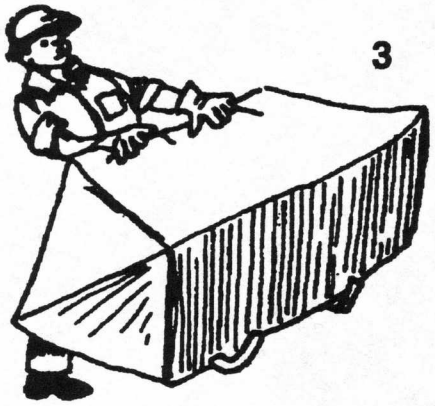

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Maintenance and Storage

Two cases protect the aluminum skin of the shelter from cracks, tears, or abrasions. A clear plastic envelope surrounds the foil shelter and allows visual inspection of the shelter, its folds, and the manufacturer's label, while sealing out dust and weather.

The sealed plastic envelope fits snugly into an outer hard plastic case protecting the shelter. The two cases are covered by a woven canvas case that can attach to a belt.

Training for the use of the shelter should be ongoing. Strive for a 30-second deployment in field conditions.

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Glossary

Air Attack — Direct use of aircraft in fire suppression.

Air Tanker — Any aircraft used to drop fire retardant or water on a wildland fire.

Anchor Point — A term associated with attack methods. Refers to an advantageous location, usually one with a barrier to fire spread, from which to start constructing a fireline. Used to minimize the chance of being "flanked" by the fire while constructing the fireline. Most anchor points originate at or near the area of origin (tail of the fire).

Aspect — A topography term for the direction towards which a slope faces.

Backfiring — When attacking a wildland fire using the indirect attack method, intentionally setting fire to fuels inside the control line to reduce fuel and contain a rapidly-spreading fire. Backfiring provides a wide defense perimeter and may be further employed to change the force of the fire's convective column. Backfiring is used to cover large areas and great distances.

Black Line — Preburning of fuels adjacent to or inside of a control line. Also denotes a condition in which there is no unburned fine fuel remaining.

Blowup — A dangerously rapid increase in fire spread.

Brush — Shrubs and stands of short, scrubby trees that do not reach merchantable size. Generally three to 20 feet in height.

Brush Engine — Any light, mobile vehicle having limited pumping and water capacity, designed for initial attack knockdown of a small wildland fire.

Burning Out — When attack on the wildland fire is direct, or parallel with the control line, intentionally setting fire to small unburned islands of fuel inside the control line to strengthen the line.

Camp	A geographic site within the general incident area equipped and staffed to provide food, water, sleeping and sanitary services to incident personnel.
Candling	Burning aerial canopy of one tree, usually from the ground up.
Canopy	The foliage or leaf covering on fuel stock.
Cat Line	A fireline constructed by a bulldozer.
Cat Pile	A berm left by a bulldozer that might contain smoldering fuels.
Chain	A fire behavior term used to figure fire perimeter size and rate of spread. Equals 66 feet.
Class A Fire	Fires burning in natural fuels, such as wood, paper, or other vegetative fuels.
Class B Fire	Fires burning in hydrocarbon fuels, such as gasoline, oil, or diesel.
Clear Text	Use of plain language in radio communication transmissions. Non-coded language.
Cold Trailing	To control a partly dead fire's edge by carefully inspecting and feeling with bare hands for any remaining embers or coals.
Command	The act of directing, managing and/or controlling personnel and resources by virtue of explicit legal, agency, or delegated authority.
Company	Any piece of equipment having a full complement of personnel.
Conduction	The transfer of heat through a solid material from a region of higher temperature to a region of lower temperature.
Conflagration	A raging, destructive fire. Often used to describe a fire burning under extreme fire weather. The term is also used when a wildland fire burns into a wildland/urban interface, destroying many structures.
Contained Fire	Fire that has completed control line around it and any spot fire associated with it. The lines might not hold under foreseeable conditions.
Control Line	A term used for all constructed or natural fire barriers used to control a fire.

Controlled Fire — Fire with control lines secured. All hot spots along the line have been extinguished, and all lines are expected to hold under forseeable conditions.

Convection — The transfer of heat by physical movement of a heated medium from one place to another. The convective column of a wildland fire can provide the medium.

Cooperative Agreements — Written documents made between unlike governmental bodies (for example, state and federal) to provide assistance in emergencies.

Crown Fire — Any fire that advances from top to top of trees or brush that is more or less independent of the surface fire.

Demob — An abbreviation for demobilization. The systematic release of personnel and resources from an incident. Demob should start during the incident's mobilization phase.

Direct Attack — Attacking the fire on its burning edge or close to it. A direct attack is usually made on a wildland fire that is moving slowly and is not too hot for firefighters to operate close the fire's edge with equipment.

Division — A large segment of a geographical fire perimeter. A division supervisor is in charge of operational activities within the division. Letters are assigned to describe a division.

Dozer — A heavy piece of equipment used to construct a fireline by clearing vegetation.

Drift Smoke — Smoke that has drifted from its point of origin and lost its original billowing form. Drift smoke can fill in canyons under stable air masses and make it difficult to see spot fires.

Drop — A term associated with air attack. Refers to dropped cargo, fire fighters, or retardant.

Dry Lightning Storm — A lightning storm where little or no rain reaches the ground.

Duff — Matted, partly decomposed leaves, twigs, and bark beneath trees and brush.

Engine	Any fire vehicle providing specified pump, water, and hose capacities.
Engine Company	Any fire vehicle providing specified pump, water, hose, and a minimum of three firefighters.
Extended Attack	Fires that go beyond three burning periods.
Extreme Fire Behavior	When a wildland fire is influenced by adverse winds, fuels, adverse topography, or any combination of the above. High rates of spread, spotting, and thermal outputs are associated with extreme fire behavior.
Fine Fuel Moisture	A term expressing the moisture level (in percentage) found in fine fuels (such as grass).
Finger	Long, narrow extensions from the main body of the fire.
Fire Behavior	The manner in which a wildland fire develops; how fuels ignite, flame development, and fire spread.
Fire Break	An existing barrier, man-made or natural, that will stop or slow an oncoming wildland fire.
Fire Flank	The sides of a wildland fire between the tail and the head. Can be identified with compass directions, left and right, hot or cold.
Fireline	The part of a control line that is scraped or dug down to mineral soil.
Fire Perimeter	The entire length of the outer edge of the fire.
Fire Retardant	Any substance or chemical applied to wildland fuels to slow the rate of combustion or reduce flammability. Generally expressed as long-term or short-term. Long-term retardants are generally chemical base, whereas short-term are primarily thickened soapy water.
Fire Season	The period of the year when wildland fires are most likely to occur.
Fire Storm	Violent convective columns caused by large continuous areas of fire, often appearing as tornado-like whirls. Can also occur from uneven terrain as fire spreads through an area. Associated with extreme fire behavior.

Firing Out	Also called firing. The intentional setting on fire of fuels between the control line and the main body of fire in either a backfiring or burning-out operation.
Firing Team	Experienced wildland firefighters and firing boss in charge of carrying out backfiring or burnout function.
Flanking	Attacking a wildland fire by working the sides of the fire between the head and tail.
Flash Fuels	Fuels like grass, leaves, pine needles, and tree moss that ignite readily and burn rapidly. Also called fine fuels.
Gradient Winds	Wind created by differing barometric pressures between high and low air-pressure systems.
Group	Resources assembled at an incident to perform a special function, not necessarily within a single geographic division.
Head of a Fire	The most-active part of a wildland fire. A developing wildland fire can have multiple heads.
Heavy Fuels	Fuels of large diameter such as logs, snags, and large tree limbs. These ignite slowly and burn slow but hot.
Helibase	A location within the general incident area for parking, fueling, maintenance, and loading of helicopters.
Hose Lay	Connecting sections of hose together from the pump to the fire location.
Incendiary Fire	A wildland fire willfully set by anyone to burn wildland or property not owned or leased by this person.
Incident Action Plan (IAP)	The incident action plan contains objectives for the overall incident strategy and specific control actions for the next operational period of an incident.
Incident Commander	The officer in charge of the overall management of the incident. He or she is responsible for building management organization based on a span of control and incident complexity. There is only one incident commander per incident.

Incident Command System (ICS) A broad term used to describe a management system for all risk incidents. It involves a combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure.

Indirect Attack A method of attack in which the control line is located along a natural barrier, firebreak, creek, river, or paved road. This attack method may be used in conjunction with backfiring.

Initial Attack (IA) Suppression efforts taken by resources that are initially committed.

Inversion A weather term used to describe when, in a given parcel of air, the air temperature increases with altitude.

Live Fuel Moisture (LFM) A term describing moisture levels (expressed in percentage) found in living brush and trees.

Local Wind A wind whose velocity and direction is determined by local heating and cooling (diurnal cycle). Local winds are low velocity, averaging less than 10 mph.

Major Fire Generally, a fire of the size or complexity that it requires a large force of fire resources and personnel and several days to control.

Mop-Up The last tactic used to suppress a wildland fire.

Mutual Aid An agreement made between like governmental bodies (such as federal and state) to provide assistance to each other in times of emergencies.

Operational Period The period of time scheduled for execution of a given set of operation objectives as specified in the incident action plan.

Overhead Personnel who are assigned to supervisory positions. This includes incident commander, command staff, directors, supervisors, and unit leaders.

Parallel Firing Method	A method where hand-tool crews operate 100 yards parallel to the fire's edge and burn out as they complete the fireline.
Progressive Hose Lay	A hose lay used on a wildland fire, usually on the flanks, to follow up a hand line made by fire crews or as a means of making a "wet line" along the fire's edge. Major components of this lay include $1^1/_2$-inch hose as a main feeder line with 1-inch hose branched off it, usually every 100 to 150 feet.
Project Fires	Fires that require a large amount of logistical and service support to suppress. Fires that need a supervisor in each of the five major functions of ICS.
Rate of Spread (ROS)	A fire behavior term used to express relative horizontal growth of a wildland fire. Expressed in total perimeter growth in chains per hour. One chain equals 66 feet.
Relative Humidity	A weather term. The amount of moisture in a given parcel of air expressed as a percentage of the maximum amount that parcel of air could hold at the same air temperature.
Strike Team	Specified combinations of the same kind and type of resources, with common radio communications and leader.
Surface Fire	A fire that burns surface litter like spruce needles, moss, and leaves.
Swamper	A term associated mostly with chainsaw operations. A swamper is the person who carries the gas and support tools for the sawyer. The swamper also pulls the cut brush and limbs to assist the sawyer
Tail of Fire	The portion of a fire opposite the head. Usually the slowest-burning part of a fire.
Task Force	A set of resources with a common leader and communications temporarily assembled for a specific mission. Task forces are generally used for firing operations and structural protection.
Thermal Belts	In mountainous regions, the middle third of the slopes that remain active with fire during evening hours. This is due to down-canyon "falling" winds that pool cooler air in canyon bottoms but leave the middle part of the slope active.

Topography	An accurate and detailed description of a place, including land surface configuration, both man-made and natural. Topography can be described in terms like "level," "steep," "broken," or "rolling."
Trenching	The action of digging trenches on a side slope to catch any material that might roll across the control lines.
Undercut Line	A control line constructed below a fire on a slope.
Unified Command	A method whereby agencies or individuals who have either geographic or functional jurisdiction at an incident can jointly determine overall objectives, select a strategy, and establish common organizational objectives. This may be implemented in a variety of ways and does not compromise the principle of having only one incident commander.
Virga	A weather term describing moisture falling from clouds but not reaching the earth's surface.
Wet Line	Control line put in by means of a progressive hose lay using 1 1/2-inch feeder line with 1-inch branch lines every 100 to 150 feet.
Wind	The horizontal flow of air relative to the earth's topography and surface.
Wye	A hose fitting permitting two or more lines to be taken from a single supply line. Used frequently in progressive hose lays on wildland fires.

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